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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

ELECTRONICS AND ELECTRICAL ENGINEERING

No. 38

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<table>
<tr><td>CONTENTS</td><td>PAGE</td></tr>
</table>

CONTENTS (Continued)   Page

ELECTRICAL ENGINEERING

- b -

USING METHODS OF OPTICAL MODELING TO STUDY OUT-OF-PHASE IMAGF ANTENNAS

VASIL'YEV, B. A., VINOGRADOV, G. K., VODOVATOV, I. A., VYSOTSKIY, M. G., and
YESEPKINA, N. A., Leningrad

[Abstract] Experiments are described on optical modeling of image antennas
with out-of-phase distribution. The studies were done to determine the pos-
sibilities of the optical modeling method for investigating the effect of
aberrations on antenna characteristics. The required amplitude distributions
of light on the optical models were produced by amplitude filters, and the
corresponding phase distributions were produced by specially made synthesized
holograms. The technique used for making the phase holographic filters is
described, and the results of using these filters are given for some antennas.
Figures 5; references 8: 7 Russian, 1 Western.

MAIN CHARACTERISTICS AND STRUCTURE OF LARGE HYBRID-INTEGRATED PHOTOMATRICES
OF HOLOGRAM MEMORY DEVICES

MATIYENKO, B. G., Novosibirsk

[Abstract] The author considers the general characteristics and structural organization of photomatrix "light-to-code" converters with random data access intended for use in read-only holographic storage devices. The optical channel of the memory unit is assumed to consist of a laser, a two-coordinate deflector and the photocarrier with the holograms. The "light-to-code" converter is a hybrid-integrated photomatrix with information capacity of the order of 10^4 photoreceiver elements. The converter provides parallel recording of digital optical information, acts as a buffer memory device for electric signals up to the instant of erasure, and provides nondestructive repeated readout of recorded data. The time parameters of the proposed photomatrix converter are discussed. Some of the practical problems of making the actual working model are considered. It is shown that optical adjustment of the address circuits can simplify realization of hybrid-integrated photomatrices by reducing the number of interconnections and simplifying crystal design. Figures 3; tables 2; references 19: 12 Russian, 7 Western.

SILICON PHOTODIODES FOR INTEGRATED PHOTORECEPTION MATRICES

KASHLATYY, R. YE., LOGVINSKIY, L. M., PAL'CHIKOV, YE. I., RYABCHENKO, V. E., and TSUKERMAN, V. G., Novosibirsk

[Abstract] An investigation is made of the feasibility of combining the process of making MOS-transistors and photodiodes to simplify the manufacture of photomatrices for holographic memories. The electrophysical characteristics of photodiodes produced in the Soviet Union are discussed. The spectral, kinetic, capacitance-voltage and current-voltage characteristics of two types of silicon photodiodes are studied. In the first type the p-layer was produced by boron diffusion, and in the second case by ionic doping. It was found that the shape of the curve for spectral sensitivity of the photodiode depended not only on the depth of the p-n junction and the thickness of the reflection-reducing coating: in the photodiodes made by ionic doping the maximum spectral sensitivity was shifted toward the infrared by the defects introduced during doping. An investigation of the kinetics of photoresponse

also revealed that the diodes made by ionic doping have poorer photo-emf relaxation properties than the diffusion-doped specimens. The techniques used for making these photodiodes are compatible with the technology for making MOS integrated circuits, and the electrophysical parameters of the diodes meet the requirements for photoreception elements in holographic memories. Apparently the deficiencies in diodes made by ionic doping are not inherent in the technique itself, but are caused by flaws in the specific procedure used in these experiments. The authors thank A. Z. Tukhvatulina and L. N. Nikitina for assistance. Figures 11; references 5: 3 Russian, 2 Western.

A PHOTORECEPTION INTEGRATED MATRIX ELEMENT FOR READOUT OF PARAPHASE OPTICAL CODE

NAYMARK, S. I. and TRET'YAKOV, V. M., Novosibirsk

[Abstract] A matrix photoreception IC element is considered that contains two photodiodes connected to the inputs of a differential stage that uses MOS transistors. The interference suppression and photosensitivity of the proposed circuit are analyzed. Test results on an experimental model are given. This photoreception element can be easily produced in matrix arrays with the following expected parameters: sensitivity to a differential optical signal about $2 \cdot 10^{-13}$ J/bit, coefficient of suppression of optical background 27-35 dB. These parameters make the proposed element attractive for use in optical memory systems. Figures 5; references 7: 4 Russian, 3 Western.

AN MOS-PHOTODIODE ELEMENT FOR SEMICONDUCTOR 'LIGHT-TO-CODE' CONVERTERS WITH
A TWO-PULSE DATA READ DIAGRAM

MATIYENKO, B. G. and NAYMARK, S. I., Novosibirsk

[Abstract] An investigation is made of the simplest MOS-photodiode element
that can be used in the "light-to-code" converters of hologram memory devices.
The photoreception element contains three MOS transistors and a photodiode.
One transistor is used as a switch for charging the barrier capacitance of
the reverse biased p-n junction of the photodiode, while the other two transistors are connected in an AND circuit and form the readout circuit of the
photoreception element. Calculations and confirming experiments showed the
feasibility of using the proposed circuit and photomatrix converters in hologram memories with information capacity of the order of 10^7 bits at luminous
energy down to 10^{-11} J/cm^2. The signal amplitude at the output reaches 2 V
and the data access rate is 1-2 MHz. Figures 9; references 6: 4 Russian, 2
Western.

SOME METHODS AND EQUIPMENT USED IN TESTS OF PHOTORECEPTION MATRIX ELEMENTS

NAYMARK, S. I., RADZYUKEVICH, V. P., and ROTSHTEYN, M. YE., Novosibirsk

[Abstract] The paper describes some methods and equipment used in testing
photoreception MIS integrated matrix elements that operate in the charge accumulation mode. The authors discuss some of the problems that arise caused
by instability of light sources and time dependence of their output power.
A measurement unit is described that uses lasers as monochromatic light sources
and has provisions for checking power drift during measurements. The electronic control equipment includes a pulse generator with programmable duration,
phase and amplitude of the controlling pulses. Provisions are made for computer control of this pulse generator. Figures 8; references 5: 2 Russian,
3 Western.

USSR   UDC 621.383.52

AN INTEGRATED-HYBRID PHOTOMATRIX FOR OPTICAL DATA STORAGE

KASHLATYY, R. YE., KOZHEVNIKOVA, A. M., KRUGLIKOV, S. V., TELITSYN, N. A.,
FIGUROVSKIY, YE. A., and YUDINA, L. P., Novosibirsk

[Abstract] A simple cell is described for an optical signal detecting matrix
that contains a photodiode and an FET switch with the gate connected to the
readout line and the drain connected to the output line. The matrix records
current pulses during charging of reverse-biased photodiodes that are dis-
charged by illumination. An equivalent circuit is given for calculating the
static and dynamic characteristics of a cell of the matrix. An experimental
16 x 16 matrix was made by standard MIS integrated circuit techniques. The
spacing of the array was 1.25 mm and the photodiode area was 0.5 x 0.5 mm.
Sensitivity on a wavelength of 0.63 μm was $2 \cdot 10^{-11}$ J at signal-to-noise ratio
of 4. Word readout time is no longer than 1 μs. Figures 4; table 1; refer-
ences 3: 2 Russian, 1 Western.

USSR   UDC 621.396.963.4

DETERMINING THE SPECTRUM OF REPRODUCIBILITY OF SIGNALS IN DIGITAL MAGNETIC
RECORDING

SERGEYEV, N. P., MUZALEV, V. V. and RYZHKOV, V. A., Penza Polytechnic Insti-
tute

[Abstract] Digital information is magnetically recorded in a binary code,
corresponding to two magnetiziation states of the carrier. In high-density
recording there occur phase distortions caused by overlap of pulses, which
requires correction of the playback signal. In order to determine this cor-
rection, it is necessary to know the signal spectrum. Accordingly, the spec-
trum of a binary pulse is calculated by approximating it with a sum of two
Gaussian pulses of opposite polarities. The results are shown in analytical
as well as graphical form. The paper was recommended by the Department Facul-
ty [Kafedora] of Automation and Mechanization of Information Processing and
Retrieval. Figures 4; references 3: 1 Russian, 2 Western.

USSR

BASIC TRENDS IN THE DEVELOPMENT OF HYBRID COMPUTER TECHNIQUES

SMOLOV, V. B., Leningrad Electrotechnical Institute imeni V. I. Ul'yanov (Lenin)

[Abstract] Considerable interest has developed over the past few decades in hybrid computer techniques, for application in areas where analog or digital techniques alone is either inadequate, inconvenient, or unnecessary. Hybrid computers and devices include those for solving elementary integro-differential equations, those for solving a special class of algebraic, transcendental, and differential equations, and complexes for coordinating the various systems. The trend in hybrid techniques closely parallels the developments in digital techniques, as evidenced by the use of large-scale integration with a programmable logic structure and by the appearance of mini-and microprocessors. This trend must take into account the need for decentralization of computer facilities, specialization of peripheral equipment, and application of promising but still nonconventional means of data processing, storage, and transmission. These means include optics, optoelectronics, cryogenics, and domain-structure devices. The trend in the development of hybrid computer techniques must, furthermore, ensure viability in every aspect of performance and application.

USSR

A PRECISION IMAGE INPUT/OUTPUT SYSTEM FOR COMPUTERS

VAS'KOV, S. T., VYDRIN, L. V., KASPEROVICH, A. N., NESTERIKHIN, YU. YE., OSTAPENKO, A. M., and SAKHAROV, I. M., Novosibirsk

[Abstract] The paper discusses development by the Institute of Automation and Electrometry of the Siberian Department of the Academy of Sciences, USSR, of a precision input/output system for computers that handles half-tone images and is based on Soviet components. Requirements of high precision, speed and universality dictated the type of system--electromechanical with a rotating drum. A system is proposed that contains two drums that are turned by a synchronous motor and carry the film with the images to be read out and reproduced, an angle sensor, readout and playback heads that are moved by a step-by-step motor, electronic readout and record channels and also a device for control and connection to the computer. The maximum image size is 13 x 18 cm, and adapters are provided for accepting smaller film sizes. The quantization step can be set at 25, 50 and 100 µm. Frame scanning (the x-coordinate) is by the step-by-step motor with a precision microscrew-nut couple,

and line scanning (the y-coordinate) is by drum rotation at 1.2 and 4 rpm.
The problem of precision in registration positioning is discussed, and the
steps taken to minimize distortions from this source are described. The sys-
tem provides at least 64 gradations of reproduced tones in a range from 0 to
2.3 units of optical density. Figures 8; references 7 (Russian).

SYNTHESIS OF THE STRUCTURE OF A SQUARE-LAW DIGITAL-ANALOG CONVERTER

MUSAYEV, M. M. and DOROSHENKO, O. N., Order of the Red Banner of Labor Insti-
tute of Cybernetics and Computing Center, Academy of Sciences, UzbSSR

[Abstract] During the creation of control and information-measuring systems
the problem arises of producing correcting signals for compensation of non-
linearity and for linearization of the characteristics of automatic measuring
devices. One of the ways to increase the precision of measurements by means
of generating correcting signals is to use square-law digital-analog convert-
ers in the feedback circuits of measuring code converters. The present paper
considers a method of constructing such a digital-analog converter which is
realized by the use of Khaar [transliteration] orthogonal functions, during
which a polynomial of the second degree is expanded into a Khaar series. An-
alytical expressions are derived which connect the parameters of certain
quadratic functions with the parameters of the circuit and the systematic er-
rors of conversion. Figure 1; references 3 (Russian).

AN ELECTRO-OPTICAL ARITHMETIC UNIT WITH SERIES-PARALLEL PLACEMENT OF THE
CONTROLLED TRANSPARENCIES

BERESTNEV, S. P., KOMPANETS, I. N. and MTSKERADZE, G. SH., Moscow

[Abstract] The paper describes an electro-optical arithmetic unit with opti-
cal realization of the decoder and logical adder that together form the arith-
metic adder. The proposed unit utilizes series-parallel arrangement of elec-
trically controlled transparencies. A collimated laser beam passes through
a stack of transparencies and a selective mask, and the output beam is focused

by a cylindrical lens on lines of photodiodes. The output signals from the diodes control the state of Shmidt triggers, and the result is displayed. The transparencies are made of a liquid crystal material. The main weakness of the proposed arithmetic unit is the poor light transmitting capacity of the liquid crystal. In conclusion the authors thank L. A. Orlov for constructive criticism, and also I. I. Klimov, V. N. Morozov, V. V. Nikitin and Yu. M. Popov for supporting the work and for discussion. Figures 4; references 6 (Russian).

A METHOD OF IMPROVING THE METROLOGICAL CHARACTERISTICS OF POWER-LAW CONVERTERS

KOSOLOAPOV, A. M. and BASKAKOV, V. S., Kuybyshev Polytechnic Institute imeni V. V. Kuybyshev

[Abstract] Power-law converters are used in such nonlinear computing devices as analyzers of random signals and rms voltmeters. Because inaccuracy is a serious limitation, a method of improving the accuracy is proposed. This method is based on the Taylor series expansion of a power function. For illustration, this principle is applied to the simple case of a squarer. Also the dynamic range of input signals can be made wider, in this way, by using linear integrated circuits and combining less accurate narrow-band converters. The paper was recommended by the Department Faculty [Kafedra] of Information and Measuring Technology. Figures 3; references 5: 4 Russian, 1 Western.

FEASIBILITY OF PRODUCING INTEGRATED CONTROLLABLE LIGHT VALVES FOR OPTICAL-DIGITAL TECHNIQUES AND COMMUNICATION

VOLODIN, YE. B. and SVIDZINSKIY, K. K., Moscow

[Abstract] An integrated structure consisting of a photodetective, an optical modulator, and a dynamic memory cell has been developed for optically controllable light valves [transparent]. It is now modified with a two-emitter input to become applicable also to electrically controllable light valves as well as to universally controllable "Latrix" light valves combining both modes of control and a matrix-type photoreceiver with a memory. The controlling integrated matrix in the form of a silicon cell on a transparent substrate is connected to a layer of optelectric material through a metallic mirror contact. The optoelectric layer is coated with a transparent common electrode. The cell operates as a capacitive voltage divider between the modulator and a transverse transistor, the collector of the latter being connected to the metallic mirror contact and its base being connected to the collector of a longitudinal two-emitter phototransistor. Figures 4; references 11: 4 Russian, 7 Western.

FOURIER TRANSFORMATION OF BINARY TRANSPARENCIES IN POLAR COORDINATES

BAN'KOVSKAYA, YE. N., MAYOROV, S. A., MAL'TSEV, L. I., and ROMANOV, YU. F., Leningrad Institute of Precision Mechanics and Optics

[Abstract] The basic element of an optelectronic angle-to-code converter is an encoder disk with a definite pattern of alternately transparent and opaque segments, in effect constituting a binary transparency in polar coordinates. The Fourier transform of such a transparency is equal to the sum of the Fourier transforms of its component segments. Analytical expressions are derived for the Fourier transforms of various characteristic track segments. These expressions should be useful for computer synthesis of holograms. The paper was recommended by the Department Faculty [Kafedra] of Computer Technology. Figures 3; table 1; references 3: 1 Russian, 1 German, 1 Western.

USE OF A LIQUID-CRYSTAL SPACE MODULATOR IN A TELEVISION SYSTEM

LUK'YANOV, A. N., NALIVAYKO, V. I., and RAPOPORT, B. I., Leningrad-Novosibirsk

[Abstract] The paper gives the results of an investigation of the feasibility of using an experimental converter with controllable memory in a small-frame television system. A liquid-crystal layer is in electrical contact with a photoconductor through a grating of conductors that are mirror reflectors of light and are isolated from each other in a glass and metal plate. On the opposite side of the liquid crystal layer is a glass wedge with a reflection-reducing coating. The working voltage is applied to the converter through semi-transparent electrodes on the glass wedge and on the photoconductor. The material of the photoconductor is chosen for prolonged optical storage and memory in strong electric fields, providing residual contrast and the capability of controlled memory. Experiments with a small-frame television system showed a ratio of useful information flux to the reading flux incident on the converter of 0.035. The experimental space-time light modulators had a sensitivity of 10^{-4}-10^{-5} W/cm^2 and resolution of 15 lines per mm. Extensive use in television systems will require further improvement of the modulator characteristics in the area of sensitivity, resolution, choice of the photo-layer and liquid crystal and matching. When combined with a high-sensitivity transmitting tube, the proposed modulator can be used for readout with a cw laser having power of 0.5-1 mW. The authors thank I. V. Tochilenko and M. A. Gofman for assistance in setting up the experiment. Figures 7; references 10 (Russian).

POWER SPECTRUM AND DISPERSION OF THE NONUNIFORMITY SIGNAL OF SCANISTORS

SOBOLEV, A. L., RUSIN, L. I., and KOZHUKHOVA, YE. A.

[Abstract] The sensitivity of scanistors is generally nonuniform over their active length. The nonuniformity signal produced by a scanistor is caused by many random factors and should be regarded as a random stationary process. As such it can be characterized in terms of its power spectrum. Twelve random samples of gold-doped p-n silicon scanistors with an integral sensitivity of approximately 4 mA/lumen each were evaluated on this basis and the results used for a more accurate determination of their threshold sensitivity, an important criterion in measurement of linear dimensions and distances. Statistical processing of their performance test data has yielded a standard deviation of close to 0.123 mV, referred to the scanistor output. Figure 1; references 4: 3 Russian, 1 Western.

ASYNCHRONOUS TRANSMISSION OF BINARY SIGNALS ALONG CHANNELS OF IKM-30/32
SYSTEMS

SARAYEV, V. N., engineer

[Abstract] IKM-30/32 equipment with pulse-code modulation (IKM) is intended
for multiplexing trunks between automatic offices. Thirty telephone channels
are established by one four-wire real cable circuity, a fixed part of which
are made available for secondary multiplexing of discrete information. With
the appearance of IKM-30 equipment at urban telephone exchanges, in addition
to the real pairs of trunks, digital circuits of IKM systems can be assigned
for operation of an automatic management system (ASU). The present paper
considers a device developed by the Kiev Branch of the Central Scientific-
Research Institute of Communications (TsNIIS) for transmission of binary sig-
nals along an IKM channel, which ensures asynchronous input of data into the
digital circuit of one telephone channel of the IKM-30/32 equipment. A varia-
tion of the staffing method developed by the author is used. Tests made of
a prototype of the device for anychronous input displayed a high noise im-
munity. The probability of error because of asynchronous input in a negligi-
ble amount in comparison with the probability of error in the digital circuit
of IKM systems. Use of the device makes it possible to use the digital cir-
cuits of high-quality IKM systems for transmission of varied binary informa-
tion. Figures 2; references 3: 2 Russian, 1 Western.

APPARATUS COMPLEX OF COMMUNICATION CHANNELS FOR ELECTRIC DISTRIBUTION NETWORKS

SKITAL'TSEV, V. S., candidate in technical sciences. VNIIE [All-Union Sci-
entific-Research Institute of Electric Power Engineering]

[Abstract] An apparatus complex of communication channels for electric dis-
tribution networks (ASK-RS) was developed by the Institute of Electric Power
Engineering and an enterprise of Minpromsuyaz: [USSR Ministry of the Communi-
cation Equipment Industry], and has been produced since 1975. The complex
consists of a special-purpose telemechanical channel, a telephone channel,
and a new feature in the form of a simplex channel for the transmission of
two command signals. Its advantages over the previous high-frequency system
(VChA-SCh) it replaces are the possibility of forcibly clearing a busy channel
in case of emergency and the adequate channel stability in various connection
modes, with the check frequency located in the voice spectrum. Also the com-
munication between dispatcher and check points is organized more economically.
Figures 4; table 1; references 5 (Russian).

Components and Circuit Elements
Including Waveguides and Cavity Resonators

ANALYSIS OF HEAT LOSSES IN CAPACITORS DURING PULSE OPERATION

KRUGLOV, A. A., Leningrad Institute of Precision Mechanics and Optics

[Abstract] The heat losses in a capacitor during pulse operation are calcu-
lated on the basis of the transient current function which describes the time
response to a unit-step voltage. The capacitor is represented by equivalent
k parallel RC-networks, a short voltage pulse is expressed as the sum of two
elementary functions. Results have been obtained for various ratios of ca-
pacitor time constant to pulse rise time and for various pulse shapes, namely
trapezoidal pulses and spikes. The paper was recommended by the Department
Faculty [Kafedra] of Materials Technology. Figures 3; references 4 (Russian).

DETERMINATION OF THE THERMAL STABILITY OF ELECTRICAL INSULATION MATERIALS AND
COIL CONDUCTORS

BERNSHTEYN, L. M. and PESHKOV, I. B., candidates in technical sciences

[Abstract] Thermal stability is a basic parameter of insulation and conductor
performance. Insulation materials were originally classified on the basis of
long service periods, but introduction of new materials has made it necessary
to resort to accelerated testing. The validity of drastically shortening the
test period and the reliability of estimating the thermal stability of insu-
lation materials or insulation systems by various methods are now examined,
on the basis of many years of practical experience and a statistical evalua-
tion of many test data. The effects of tension, thermal aging, and thermal
shock on the thermal stability of various grades of enameled copper wire were
studied extensively. The results indicate that the proper selection of test
temperature, test period, diagnostic factors, and "end point" criterion re-
quire a great deal of information about the actual service conditions and
about the processes occurring in each material during thermal aging. The ten
cycles at three different temperatures, with aging periods according to the
GOvernment STandard 10518-72, do not provide an adequate basis for estimating
the thermal characteristics of insulation. Aging periods should be appropri-
ately varied for each material or system. It is most preferable to continue
a test till failure occurs. Particularly important is establishing the cor-
rect "end point" criterion, namely the test voltage, which largely depends on
the service voltage. Tables 4; references 4: 2 Russian, 2 Western.

A CONTROLLED ATTENUATOR USING p-i-n DIODES FOR COAXIAL MICROWAVE LINES

ISHCHENKO, A. I., KOZHUSHNYY, V. A., and PEREKUPKO, V. A.

[Abstract] In the design of controlled attenuators for coaxial communication
lines in the short end of the centimeter waveband, it is desirable to use
wide-band waveguide structures (H-andΠ-shaped waveguides) with p-i-n diodes,
achieving effective heat transfer away from the diodes, superior matching of
transient properties of the microwave structure and lower losses than in co-
axial-strip systems. A schematic diagram of one design of such an attenuator
with a waveguide section containing a series-produced diode is presented. The
results of testing of the attenuator demonstrated the possibility of using
such a structure in coaxial transmission lines for wide-band microwave trans-
mission systems. Increasing the number of series-connected p-i-n diodes in
the microwave line results in a proportional increase in transmission losses
in comparison with a homogeneous attenuator design. However, when diodes are
selected for minimum losses, the total transmission losses can be reduced to
1.2-1.5 dB. A three-diode design allows the level of switched microwave power
to be increased, because the power dissipated is distributed among the diodes
in proportion to the attenuation introduced. Figures 2; references 2 (Russian).

UDC   531.71.087.92

FUNCTIONAL OPTOELECTRONIC ANALOG-TO-DIGITAL DISPLACEMENT TRANSDUCERS BASED
ON FIBER OPTICS (SURVEY)

SHAPOVALOV, V. M., MARKOV, P. I., candidates in technical sciences, KHOVANSKIKH,
M. D., and ZYRYANOV, L. P., engineers

[Abstract] Optoelectronic analog-to-digital displacement transducers feature
a high response speed, a wide range of functional applications, stability of
performance parameters, feasibility of microminiaturization, and simple means
of eliminating the ambiguity error. In the first group of these devices the
optic fibers simply transmit radiation energy from an encoder to a receiver
along fixed trajectories, and the receiver generates electric output signals.
In the second group of these devices the optic fibers function as quantizers,
encoders operating on the principle of geometric image transformation, and
transmitters of information contained in radiation. The design and the per-
formance of such devices are reviewed here and the trends in their applica-
tion are indicated. These applications include one- and two-coordinate mea-
suring instruments, instruments with mechanisms for deflecting a light beam,
instruments with an optical input, automatic instruments with a digital out-
put, instruments with a visual display, and instruments for measurement of
electrical quantities and analog-to-digital conversion of nonelectrical quan-
tities. Figures 3; references 18 (Russian).

UDC   621.314.224:621.314.6

STABLE OPERATING MODE OF MEASUREMENT ORGANS OF DEVICES FOR PROTECTION AND
REGULATION OF HIGH-POWER CONVERTERS

ALLILUYEV, ALEKSEY ANATOL'YEVICH, candidate in technical science, Assistant
Novocherkassic Polytechnical Institute

[Abstract] This article is dedicated to analysis of the steady-state operat-
ing mode of the measurement organ in a three-phase bridge transformation cir-
cuit with a long time constant in the load circuit with alternating conduc-
tion of two and three rectifiers [ventil'] of the converter. The usual sim-
plifying assumptions are made. The analysis is performed for cases when cur-
rent transformers in the measurement organ are connected in a star circuit
and a triangle circuit and their magnetization characteristics are linear.
Analytic expressions are produced for calculation of the instantaneous and
integral current characteristics at the output of the measurement organ.
Figures 3; table 1; references 5 (Russian).

ANALYSIS OF THE OPERATION OF MICROWAVE PHASE INVERTERS IN THE NONLINEAR MODE
AT HIGH SIGNAL LEVELS

OMELYANYUK, I. V. and TOLSTIKOV, YU. V.

[Abstract] The maximum signal level in a microwave phase inverter based on
varicaps is limited by thermal breakdown of the varicap. The value of $\Delta \phi$
and harmonic U_c can be found as a function of signal level by numerical ex-
pansion of the signal passing through the phase inverter into a Fourier series,
which requires determination of the numbers representing the form of U_c as a
function of time and signal level. This task is performed by analysis of the
equivalent circuit of the phase inverter, a combined circuit of elements with
both concentrated and distributed constants (sectors of long lines and vari-
caps). A generalized mathematical model of such a circuit is presented, con-
sisting of a nonlinear system of equations of state. A program for analysis
of a microwave reflected phase inverter based on a type 3A610 varicap, achiev-
ing a smooth phase shift on the order of 250° with a variation in U_y from 1
to 40 V is written for the M-222 computer. Using the equations produced as
a result of analysis, it is possible to determine the maximum signal power in
the line using reflective phase inverters of this type on the basis of per-
missible phase instability or permissible levels of harmonics and the assigned
instability of signal power. Figures 2; references 4: 3 Russian, 1 Western.

DESIGN AND EXPERIMENTAL INVESTIGATION OF AN AUTODYNE FREQUENCY CONVERTER
BASED ON A GUNN DIODE

BORODOVSKIY, P. A., BULDYGIN, A. F., and UTKIN, K. K.

[Abstract] A rather simple method of designing an autodyne frequency con-
verter based on the general theory of crystalline mixers is studied and the
results are presented from experimental investigations which are compared
with the calculation results. A new approximation of the volt-ampere char-
acteristic of the Gunn diode is used in the calculation, allowing analytic
derivation of formulas for the output power, efficiency and conductivity of
the mixer conversion matrix. The calculated variation of generated power
and output conductivity of the Gunn diode at the intermediate frequency with
bias voltage, as well as the power transfer factor with load resistance are
compared with the measured results. The studies performed show that when the

parameters of the autodyne frequency converter circuit are properly selected, the optimal microwave load should be about 30 R_{thr}, while at the intermediate frequency it should be about 10 R_{thr}, where R_{thr} is the measured impedance of the Gunn diode at the threshold voltage. The power transmission factor in this case will be 5-10 dB. The greatest values of power transmission factor and lowest noise are achieved at the boundary of self-excitation of low-frequency oscillations, as in the case of a tunnel diode. Figures 5; references 10: 5 Russian, 5 Western.

USSR   UDC   681.3.05+681.2+621.391

EFFECTIVENESS OF DIGITAL METHODS OF ERROR CORRECTION IN ANALOG-TO-DIGITAL CONVERTERS

MOISEYEV, V. S., Leningrad Institute of Precision Mechanics and Optics

[Abstract] The error of analog-to-digital converters can be reduced by digital correction of the output. The effectiveness of such methods is evaluated here by the criterion of tentative misinformation capacity, i.e., the informational gain defined as the difference between this misinformation capacity without and with correction, respectively. Such a criterion accounts for all systematic as well as random components of the net error. The gain characteristic can serve as a basis for various specific criteria applicable under various conditions where any combination of accuracy, response speed, reliability, and cost are involved. A particular correction method can be selected accordingly and, furthermore, optimized. One such method consists of statistical averaging of S conversions for each of M standard measures, with subsequent correction of the systematic error in conversions. Another method consists of M checks against standard measures, with subsequent correction of the systematic error in N conversions and averaging of a lot of S conversion samples. It is shown here how the first method can be applied to correction of a systematic error, the second method can be applied to correction of a random error, and either method can be applied to simultaneous correction of a systematic and a random error. The paper was recommended by the Department Faculty [Kafedra] of Computer Technology. Tables 2; references 3 (Russian).

USSR   UDC 537.312.62:621.3

APPLICATIONS FOR SUPERCONDUCTIVITY IN ELECTRICAL ENGINEERING

GLEBOV, I. A., Academician, Academy of Sciences, USSR, DANILEVICH, YA. B., dr in technical sciences, and SHAKHTARIN, V. N., candidate in technical sciences

[Abstract] Recent progress in the production of superconductor materials with better characteristics has contributed to their usefulness in several areas of electrical engineering practice. One outstanding example is the use of superconductor excitation windings for large turbogenerators. Based on a successful model unit with a 1200 kW excitation winding a rotor (770 mm diameter), essentially a revolving helium-cooled cryostat with vacuum insulation, a 20 MVA – 6.3 kV turbogenerator has already been tested and made ready for pilot production. A 300 MVA – 3000 rpm unit is being developed. The superconductor windings, a niobium-titanium alloy embedded in copper, can carry a nominal current of 1000 A with a 20 percent overload factor over a cross section of 2x3.5 mm^2. The performance of such a turbogenerator is as high as or superior to that of a conventional hydrogen-cooled one of about three times the size. Figure 1; tables 2; references 2 (Russian).

USSR   UDC 621.313.322.016.354.001.24

STATIC STABILITY OF A SYNCHRONOUS MACHINE WITH A SUPERCONDUCTING EXCITATION WINDING

GLEBOV, I. A., academician, KASHTELYAN, V. YE., KICHAYEV, V. V., candidates in technical sciences, and KOROL'KOV, S. A., engineer VNIIelektromash [All-Union Scientific-Research Institute of the Technology of Electric Machinery and Equipment Manufacture]

[Abstract] The stability ranges of a turbogenerator with a superconducting excitation winding and with either an electromagnetic shield or a damper shield are determined from the fundamental equations of the two-reaction theory. The time constants, the transient torques, and the free oscillations are calculated accordingly, as a basis for design optimization. This is then illustrated on a 20 MW machine with a maximum natural frequency of 2.2 Hz and a subtransient time constant in the quadrature axis equal to 0.072 sec. A damper shield made of 18 mm thick copper and placed within the zone of conventional operating temperatures will have a time constant equal to 0.27 sec and yield a shielding factor of approximately 50 at the 50 Hz operating frequency. References 7: 5 Russian, 2 Western.

Instruments and Measuring Devices and Testers;
Methods of Measuring

USSR   UDC   534.8

ACOUSTIC IMPEDANCE MEASURING INSTRUMENT

ARTYKOV, T. A. and KHAKIMOV, O. SH., Tashkent State Pedagogical Institute imeni Nizami

[Abstract] An acoustic impedance measuring instrument developed by the authors is described. The instrument, which is based on measurement of the complex coefficient of a sheer wave at the solid-liquid boundary, measures the complete acoustic impedance of liquids at frequencies from 0.25 to 1 GHz. Graphs are presented of the frequency dependences of the sheer viscosity and the elasticity of castor oil and cotton oil. The results of the measurements satisfactorily agree with data from the literature. Expansion of the frequency range of investigations of transverse waves indicates that in castor oil the bulk and sheer viscosity relax simultaneously and their ratio remains constant in the range investigated. Figures 2; references 2 (Russian).

USSR   UDC   621.3.037.3

EXPERIMENTAL EVALUATION OF THE PERCEPTION CHARACTERISTICS OF DIGITAL AND ANALOG READOUT ON MEASURING INSTRUMENTS

BOGOSLAVSKIY, G. YE., candidate in technical sciences, DINABURG, M. A. and FAYNBERG, V. I., engineers

[Abstract] A comparative study was made by the Special Design Office at the "Tochelektropribor" [Precision Electrical Instrument] imeni Komsomol Ukrainu Plant in Kiev to evaluate the perception by a technician of digital and various analog readouts. This study was made with the model F204 digital voltmeter, the model M1730 electromechanical millivoltmeter, the industrial model F5090 millivoltmeter with an electroluminescent two-coordinate discrete-analog or digital readout, and the laboratory model F5145 voltmeter with one-coordinate linear readout based on light-activated diodes. Both technical parameters of the instruments and psychophysiological factors affecting the operator, such as fatigue, were considered in establishing the trends of reading errors during regulation of periodically varying quantities. The resulting exponentially decreasing curves, based on an evaluation of test data by the method of least squares, represent the typical trend in adaptive processes. This study has revealed that digital readout is unsuitable for checking and regulating any fast process by intervention of a human operator. Electromechanical instruments with their inherent inertia are suitable for checking and regulating only static or slowly varying processes. Discrete-analog

readout ensures highly reliable checking and regulating of dynamic processes either manually or automatically. It is particularly effective in presenting composite data pertaining to several parameters measured by a group of instruments for plotting histograms. Figures 2; tables 3; references 3 (Russian).

AUTOMATIC INSTALLATION FOR RAPID TESTING OF SMALL PERMANENT MAGNETS

BOLDYREV, V. T., VAZHINSKIY, N. M., SEMCHENKO, A. D., and STEPANOV, B. M.

[Abstract] An earlier work by A. D. Semchenko presented the foundation of design and description of the circuit of a measuring device for automatic testing of magnets not over 20 mm in length in the direction of magnetization and with constant cross section. This article presents a schematic diagram of the installation, in which a permeameter and a capacitor form an oscillating circuit which is the primary circuit for contactless testing of the magnets. The difference in emf arising in the process of testing of magnets at the output of the counter-connected measurement coils is fed to the input of a low-frequency electronic amplifier with a long time constant. The coils are balanced by means of two potentiometers. From the moment that a magnet is loaded into the hopper until it is dropped into containers marked "good" or "reject," the magnet passes through the following operations: automatic orientation, feeding with a fixed time interval into the test gap of the permeameter and stopping in the gap, transportation from the test gap and dropping into the proper container. The elements providing for this automatic cycle of testing are: a vibration loading device, feeding trough, transportation mechanism and reject gate. The device can test 900 magnets per hour, and has an error rate of ± 3 percent. Figures 2; references 2 (Russian).

ERRORS OF CONVERSION OF RECTANGULAR-COORDINATE AUTOCOMPENSATORS WITH STATIC
BALANCING

ABARINOV, YE. G., candidate in technical sciences, and MELIK-SHAKHNAZAROVA,
I. A., engineer

[Abstract] This is one of a number of papers presented under the general
heading "Converters of the Parameters of Electrical Complex Magnitudes Into
Standardized Signals." The paper describes a rectangular-coordinate d-c
autocompensator with static balancing, using intermediate conversion of d-c
into a-c voltage, and intended for operation in a continuous frequency band--
not a fixed frequency. Its errors of conversion are analyzed and expressions
are derived which make it possible to discard the depth of feedback of each
channel, allowing for the phase errors of all the principal units of the auto-
compensator. The principal characteristics are presented of a converter oper-
ating in the 50-5000 Hz range, for use in the autocompensator. Figures 3;
references 5 (Russian).

IMPEDANCE-INTO-VOLTAGE MEASURING TRANSDUCERS WITH THE POSSIBILITY OF POLARI-
ZATION OF THE OBJECT UNDER STUDY

NOVITISKIY, S. P., candidate in technical sciences, and BURENKOV, I. I.,
engineer

[Abstract] This is one of a number of papers presented under the general
heading "Converters of the Parameters of Electrical Complex Magnitudes Into
Standardized Signals." Methods are considered for construction, using pas-
sive and active components, of impedance-into-voltage measuring transducers
in the frequency range from zero to 200 kHs with values of the impedance
modules in the 0.1--10^7 ohm range. These transducers make it possible to
maintain a specified regime of the object under study with respect to direct
current. These measuring transducers, based on operational amplifiers, are
used as the basis of a measurer of the impedance of electrochemical systems.
The principal technical characteristics of the transducers are presented. In
comparison with series produced R568 and R5021 bridges, intended for electro-
chemical investigations, the proposed measuring transducers has a two order
of magnitude higher speed of response and an order of magnitude wider band
for measuring impedances. It makes possible assignment of a specified regime
of polarization of the electrode investigated by an exterior controller, which
eliminates the necessity for a link-up of a potentiostat with the measurer.
Figures 4; references 8 (Russian).

CAPACITANCE AND CONDUCTIVITY CONVERTER, OPERATING IN CONTINUOUS FREQUENCY
RANGE

AGAMALOV, YU. R., candidate in technical sciences, KNELLER, V. YU., dr in
technical sciences, and KURCHAVOV, V. I., engineer

[Abstract] This is one of a number of papers presented under the general
heading "Converters of the Parameters of Electrical Complex Magnitudes Into
Standardized Signals." In various fields of science and technology (e.g., in
electrochemistry and geophysics, medicine and biology, construction of radio
components) problems appear which require automatic measurement of complex
quantities of alternating current components in a continuous frequency range.
The present paper describes a converter--one of the first automatic devices
which make it possible to solve the most frequently occurring problem of pre-
cise measurement of the reactive C_x and active G_x components of capacitive
units in the frequency range from 50 Hz to 20 kHz by a parallel two-element
equivalent circuit, to which a multielement RC two-terminal can be brought
at any fixed frequency. Technical characteristics of the converter are shown,
as well as the basic circuits of its components. Figures 6.

CONVERTERS OF IMPEDANCE PARAMETERS FOR DIGITAL DEVICES AND SYSTEMS

BAKHMUTSKIY, V. F., candidate in technical sciences, and NIKOLAYCHUK, O. L.
and STEPKIN, V. I., engineers

[Abstract] This is one of a number of papers presented under the general
heading "Converters of the Parameters of Electrical Complex Magnitudes into
Standardized Signals." The principal characteristics of existing methods
of measuring impedance parameters are discussed. In contrast to methods
described in the literature for creating converters of impedance parameters,
the authors provide coupling with ordinary (nonspecialized) analog-to-digital
converters of push-pull integration and a subsequent process of conversion.
During this, the requirements are satisfied with respect to precision, speed
of response and noise immunity of the devices, and, in addition, parametric
standardization is assured with many other converters. Block diagrams are
presented of the F84011 converter of capacitor parameters and the F-84012
converter of inductance coil parameters. The principal characteristics of
these converters are listed. Figures 2; references 12: 9 Russian, 3 Western.

USSR   UDC 621.317.762:621.376.2

MEASUREMENT OF A SMALL FRACTION OF AN INTERFERENCE FRINGE BY THE METHOD OF
TIME INTEGRALS

ZAKHAROV, V. P., SNEZHKO, YU. A., YEVTIKHIYEV, N. N., and TYCHINSKIY, V. P.

[Abstract] An analog instrument has been developed for recording extremely
small aperiodic displacements. It is based on the principle of linear-time
conversion, with the aid of interferential modulation and subsequent forma-
tion of a time-interval pulse proportional to the phase difference between
interfering rays. The instrument includes a photoreceiver, a Schmitt trigger,
two NAND logic circuits, and an RS-trigger. The operating parameters, name-
ly the modulation amplitude and frequency, must be optimized for high ac-
curacy and resolution in a noisy environment. Typical modulation according
to a linearly periodic law is analyzed and the instrument performance is il-
lustrated in recording the thermal expansion of a specimen as a function of
time. Figures 3; references 8: 5 Russian, 3 Western.

USSR   UDC 621.317:621.382

DEVICE FOR TEST CHECKS OF LARGE-SCALE INTEGRATED CIRCUITS

PELIPEYKO, V. A., candidate in technical sciences

[Abstract] In many organizations which use comparatively small lots of in-
tegrated circuits or make use of computing means, constructed on a basis of
integrated circuits and large-scale integrated circuits, application of com-
plex and expensive test systems is economically and technically not justified.
For use under such conditions, the Institute of Electronics and Calculating
Techniques of the Academy of Sciences, Latvian SSR, developed the compact and
inexpensive "Logikon" test automat. This device is described with the aid
of a functional-block diagram. The unit is constructed on a basis of inte-
grated circuits and is made in a desk-top form. Series production of the
"Logikon" (UFSK-1) has started. Figure 1.

TESTER FOR MONITORING OF THE ASSEMBLY OF RADIOELECTRONIC EQUIPMENT AND HYBRID INTEGRATED CIRCUITS

GANOPOL'SKIY, L. S., RYABININ, V. I., engineers, and TSYPIN, B. V., candidate in technical sciences

[Abstract] One of the most time-consuming operations during production of radioelectronic equipment is regulation after assembly. This operation is complicated by the fact that in an assembled circuit it is practically impossible to determine the soundness of transistors and the agreement of resistors with their rating because of the presence of circuits parallel to the unit being measured and which shunt it during measurement. In the present paper a method of eliminating the effect of shunting circuits, and a circuit for measuring the back current of the collector junction of a transistor used in an amplifier stage are considered. The principles of measurement discussed form the basis of a tester for monitoring of the assembly of radioelectronic equipment and hybrid integrated circuits. The tester was developed at the Penzensk Affiliate of VNIITIPriborstroyeniye [All-Union Scientific-Research Technological Institute of Instrument Making]. The most efficient use of the tester is during tuning of transistorized equipment which is produced in a small-scale series, repair work, statistical analysis of circuits after climatic, electrical and other forms of tests, as well as for monitoring the parameters of components and the quality of connections during production of hybrid microcircuits. An external view of the tester is shown and its principal technical characteristics are presented. Figures 4; references 4: 3 Russian, 1 Western.

DYNAMIC ERROR OF A SINGLE-CHANNEL MULTICOMPONENT MEASURING SYSTEM

ZAIKO, A. I., Ufa Aviation Institute imeni S. Ordzhonikidze

[Abstract] The dynamic error of a multicomponent measuring system with a normal stationary random input process is calculated, assuming the dynamic errors of the individual components to be unknown. The analysis, on the basis of a posteriori probability, is applied to such a single-channel system consisting first of two and then of three components. The dynamic errors of the components are then also calculated. Even when the latter are statistically independent, however, their contributions to the dynamic error of the

system are still correlated. Consequently, a plain addition of dynamic errors is not accurate. The paper was recommended by the Department Faculty [Kafedra] of the Theoretical Basis of Electrical Technology. Figures 2; references 4 (Russian).

A TOLERANCE INSPECTION GAUGE FOR INVESTIGATION OF THE RELIABILITY OF ELEMENTS AND FUNCTIONAL COMPONENTS IN RADIOELECTRONIC EQUIPMENT

VLASOV, N. I.

[Abstract] Thermal radiation is used as an indicator of defective micro-miniature components in inspection of radioelectronic printed-circuit assemblies. As a source of information, thermal radiation is characterized by a large capacity and responsiveness to all the most significant physical processes affecting the performance of a device. An instrument has been developed which greatly reduces the effect of ambient conditions and of thermo-receiver instability on the values of the thermal inspection parameters. It compares, according to a program covering specific test points, the intensities of thermal fluxes coming from the test object and from a reference specimen under operating conditions. Essentially, with the aid of a modulator, thermal fluxes are alternately transmitted through a system of optics to the photoreceiver and subsequently converted to electric signals proportional to the thermal luminance. The instrument includes a mechanical scanner, an electronic commutator, a synchronous sweep circuit, and necessary accessories. It furthermore includes a tolerance setter as well as a lower-tolerance comparator and an upper-tolerance comparator, allowing it to operate as a "go or no-go" gauge. With a bolometer used as thermoreceiver, it can detect $0.1°C$ changes in the temperature of a test object under $\pm 10°C$ fluctuations of the ambient temperature. Figure 1; references 4: 3 Russian, 1 Western.

A METHOD OF IMPROVING THE EFFECTIVENESS OF ZERO ORDER EXTRAPOLATORS

DOLINOV, S. N., Leningrad Electrotechnical Institute imeni V. I. Ul'yanov (Lenin)

[Abstract] Most widely used in adaptive systems are zero order predictors, their main advantage being a zero delay in signal restoration. Their low effectiveness is a serious limitation and, therefore, a method of improving the effectiveness is proposed here. The gist of this method is smoothing the restored signal with lowpass filters. The principle is demonstrated for the rather general case of a centered stationary Gaussian input signal, a zero order discretizer with a fixed and shiftable aperture equal to or a multiple of the weight of the last digit, and channels sampled by adaptive discretization. The signal spectrum at the output of such an extrapolator is analyzed and the gain in accuracy by using filters is calculated, this gain increasing with a smaller predictor aperture and with a smoother signal. The paper was recommended by the Department Faculty [Kafedra] of Information and Measuring Technology. Figures 4; table 1; references 3: 2 Russian, 1 Western.

INSTALLATION FOR STUDY OF THE CHARACTERISTICS OF SYNCHRONIZED MICROWAVE OSCILLATORS

UNANYAN, S. M., and FOMIN, N. N.

[Abstract] A measurement installation is described which allows rather rapid determination of the variation of output power of an oscillator with frequency and level of external excitation and tuning of oscillators in order to improve their synchronization parameters. The measurement device is made of series-produced hardware and microwave elements. Figures 2; references 7: 4 Russian, 3 Western.

ANALYSIS OF LINEAR ELECTRIC CIRCUITS AND THEIR SENSITIVITY BY MEANS OF
INVERSE MATRICES

SHAKIROV, MANSUR AKMELOVICH, candidate in technical sciences, Dotsent,
Leningrad Polytechnical Institute

[Abstract] Calculation of the stable mode in a linear circuit is generally
performed by the Gaussian exclusion method using a system of equations of
equilibrium of the circuit. This article demonstrates that the form of cal-
culation of the circuit by means of an inversion matrix can correspond to an
equivalent transform of the circuit, based on which the physical sense of the
elements of the inverse matrix is made clear. This has allowed a number of
important equations to be derived for more effective analysis of circuits,
including the calculation of all circuit functions and their sensitivities.
The inverse matrices of equations contain important information concerning
the full transfer functions of homogeneous and hybrid linear electric circuits
in explicit form and can be used, together with calculation of currents and
voltages in the branches, to produce all circuit functions and sensitivities
based on any circuit parameter. It is thus a more attractive method for cal-
culation of equilibrium equations than the method using the LU expansion. An
example is appended, involving the analysis of a substitution circuit for a
low-frequency amplifier. Figures 4; tables 2; references 10: 9 Russian, 1
Western.

IMPROVING THE RESOLUTION OF THICK-FILM TECHNOLOGY FOR THE PRODUCTION OF
HYBRID LARGE-SCALE INTEGRATED CIRCUITS

FILATOV, V. N. and BORISOVA, G. V., engineers

[Abstract] One way to increase the scale of circuit integration is to im-
prove the resolution of the thick-film technology, optimum resolution being
attainable by contact printing with bimetallic stencils. A study was made to
determine how this resolution is limited by the stencil thickness, by the
spreadability of organic substrate and binder materials, and by the distribu-
tion of components relative to the stylus movement. The optimum stencil thick-
ness was found to be 50 μm. Most precisely defined are lines parallel to the
stylus movement, with a density of 5 lines/mm and a minimum line width of 50
μm being quite feasible. Figures 5; tables 2; references 2: 1 Russian, 1
Western.

CALCULATION OF TRANSIENTS IN NONLINEAR RC-NETWORKS IN MONOLITHIC INTEGRATED
MICROCIRCUITS

D'YAKONOV, V. P. and SEMENOVA, O. V., Smolensk Branch of the Moscow Power
Engineering Institute

[Abstract] In monolithic microcircuits for pulse operation the capacitive
element is usually a p-n junction whose capacitance depends on the applied
voltage. Transients in such nonlinear RC-networks are calculated with the
aid of a digital computer, for the case of an arbitrary voltage input signal
$e(t)$ and for input signals which may come from a logic circuit, a transistor-
ized switch, an operational amplifier, a discharge-type current-stabilizing
two-pole network, or a charge-type current-stabilizing two-pole network.
The calculations were based on the fundamental system of transient equations
with a voltage-dependent capacitance, with appropriate initial conditions
and time constants. The computer program was based on the Runge-Kutta method,
implemented in 11 steps on a "Nairi-K" computer with 10 points from $t= 0.099$
to $t= 1.000$ (the results plotted in the form of universal curves). The paper
was recommended by the Department Faculty [Kafedra] of Industrial Electronics
and Computer Technology. Figures 5; table 1 (in the Appendix); references
4 (Russian).

APPLICATION OF SERIES K155 MICROCIRCUITS

ALEKSEYEV, S., Moscow

[Abstract] Examples are given of possible applications of series K155 micro-
circuits, with the radio amateur in mind. The K1IYe551 can be used in fre-
quency dividers which form second pulses in a timepiece or time intervals in
a frequency meter. A time pattern is shown and the hookup technique is de-
scribed for creating multistage frequency dividers. The K155IYe2 consists of
a flip-flop with a counting input and a counter with a scaling factor of five.
By internal connection of two leads a binary-coded decimal consecutive counter
is obtained, functioning in 1-2-4-8 code. The hookup for obtaining multistage
counters is shown. The K155ID1 decoder is used to decode the states of the
K155IYe2 decimal counter. The K155ID1 has four inputs, which are connected
to the outputs of the counter functioning in 1-2-4-8 code, and 10 outputs,
which are connected directly to the cathodes of a digital readout tube. A
special feature of the K155IYe2 microcircuit makes it possible to use it in

the output stages of frequency dividers of digital frequency meters which require that formation of the time interval begin with minimum delay after the trigger pulse. The K155IYe2 can also be used to assemble dividers with other scaling factors, such as six and seven, the latter for use as a calendar counter. The K155IYe4 lends itself well for use in electronic timepieces. It contains a counting flip-flop and a divider with a scaling factor of six, making it possible to use it as a counter for units of ten seconds and minutes. The K155IYe5 contains a counting flip-flop and a divider with a scaling factor of eight consisting of three flip-flops connected in series. The K155IYe5 can be used in frequency dividers of electronic musical instruments and in various kinds of selectors, as well as a divider with a scaling factor of 10 or six. The use of microcircuits of this series in electronic timepieces is illustrated by a diagram of second, minute, and hour counters assembled from K155IYe2 and K155IYe4 microcircuits. K155TM5 and K155TM7 microcircuits function as intermediate storage elements, which can be connected between the outputs of the counter and inputs of the decoder to eliminate flickering of digits in the process of counting when using digital meters. The K155TM5 contains four static flip-flops, each of which has an information input and a clock input and a direct output. The flip-flops in the K155TM7 contain an inverting output in addition. Figures 15.

POLARIZATION SINGLE-POLE MODULATOR BASED ON VARACTOR DIODES

MAKARENKO, A. S.

[Abstract] A polarization single-pole modulator based on varactor diodes is
described, allowing significant frequency shift to be achieved while suppress-
ing the carrier and the opposite side band by at least 32 dB. The design
method is presented, plus experimental characteristics of a modulator based
on a single azimuthal element and three series-connected elements. The equa-
tions produced were used as the basis for writing a program for calculation
of the spectrum of the modulator on an MIR computer. The modulator uses
type 1A403G varactors with an initial capacitance of 0.25 pf with a bias volt-
age of -15 V and a loss resistance of 8 ohms. The modulator unit consists of
a coaxial waveguide with a wave impedance of 100 ohms, with four pairs of
varactors with adjustment elements in the gap of the waveguide. In order to
determine the characteristic peculiarities of the controlled section, numeri-
cal calculations were performed with ideal ℓ90° sections and matching junc-
tions. The calculations and experiments demonstrated that it is possible to
produce a semiconductor polarization modulator of this type with good spectral
characteristics. The frequency shift can be as great as tens of megahertz.
Figures 7; references 7: 6 Russian, 1 Western.

STUDY OF SEMICONDUCTOR MICROWAVE OSCILLATORS WITH MAGNETIC TUNING

GOLOLOBOV, V. P., TSYMBAL, V. I., and SHELAMOV, G. N.

[Abstract] One approach to a method of design of both diode and transistorized
oscillators with magnetic tuning is studied, based on the use of preliminarily
calculated or measured impedance characteristics of the basic elements of the
oscillator (ferrite resonators and semiconductor devices), and new circuits
for oscillators of this type are suggested. The characteristics of microwave
oscillators, sequentially covering a frequency band of four octaves, meet the
basic requirements placed on oscillators for radio receivers and microwave
measurement apparatus. Figures 3; references 5: 3 Russian, 2 Western.

MODEL AOD101A...D HIGH-SPEED DIODE OPTRONS

NOSOV, YU. R., dr in technical sciences, BER, A. YU., candidate in technical
sciences, NEYGAUZ, L. M., and POSTNIKOVA, N. V., engineers

[Abstract] A new series of diode optrons has been developed with a sufficient-
ly far standardized construction. The source of near-infrared radiation is
either a GaAs structure operating at $\lambda \approx 0.93 \pm 0.95$ μm wavelength, entirely
compatible with the spectral sensitivity of silicon photoreceivers, or a
ternary AlGaAs heterostructure operating at a $\lambda \approx 0.8 \pm 0.9$ μm wavelength where
high-speed switching within only tens of nanoseconds overrides other require-
ments. The photoreceiver is a silicon pin-structure with a photosensitivity
near the theoretical attainable 400-600 mA/W and with a short time constant
of the order of 10^{-8} s, which can operate at low inverse voltages (1 V or a
fraction thereof). Figures 3; table 1.

TRANSISTORIZED OPTRONS

VARLAMOV, I. V.

[Abstract] Low-cost high-speed optoelectronic decoupling devices have been
developed on the basis of series 249 microcircuits with light-activated diodes
and phototransistors. The trend of the current-voltage characteristics of
such transistors is largely determined by the modulation effect occurring
within the high-resistance collector region. A shunt resistor across the
emitter junction can reduce the recombination time during operation in the
saturation mode. These optrons can operate as switches with a high degree
of static noise immunity, because of the large energy gap characteristic of
GaAs, and as modulators of small signals, as well as two-terminal devices.
Figures 2; table 1; references 8: 6 Russian, 2 Western.

USSR

EQUIPMENT FOR COMMUNICATIONS VIA SATELLITE

Moscow RADIO in Russian No 10, Oct 77 pp 20-22

LABUTIN, L., UA3CR

[Abstract] A survey is given of transmitting and receiving equipment de-
scribed in earlier issues of RADIO which can be recommended or adapted for
use by radio amateurs for communications via satellite. It is assumed that
the most widely used frequencies will be employed, i.e., 28 MHz for reception
and 144 MHz for transmission. R-250 and R-250M receivers are very popular
among shortwave radio amateurs but they lack the 28 MHz band. A summary is
given of a technique for redesigning the R-250 receiver suggested in RADIO,
No 8, 1972, by selecting a quartz oscillator with the lowest-order harmonic
to obtain the necessary segment of 28 MHz band. The UW3DI transceiver can
also be used if a 23 MHz quartz oscillator is employed. Vacuum tube convert-
ers for the 28 to 29.7 MHz range are discussed, in terms of their requirements
and limitations. Recommendations are given on duplicating the design of a
receiver with direct frequency conversion assembled entirely out of semicon-
ductor devices. A number of transmitters described from 1972 to 1976 can be
used at the elementary stage of communications via satellite. Required regula-
tion of the transmitter's output power is provided for in tube designs by
smooth or stepped variation of the shield grid voltage of the tube in the
final stage, and of the overall supply voltage in transistor designs. Features
of a very simple general-purpose transmitter are described, which include the
ability to transmit telegraph and SSB signals. Mention is also made of a
two-tube design. A transceiver unit is described which makes it possible for
any amateur to communicate via a satellite with an orbit altitude of 1000 to
1500 km. Recommendations are given on altering the design of a combination
tube and semiconductor transmitter by replacing obsolete transistors with new
and thus reversing the polarity of the supply voltage. Attention is drawn to
the main disadvantage of transistor amplifiers, the frequent occurrence of
parasitic oscillations, which are difficult to cope with. References are
cited for further study of this problem. A brief list is given of useful
articles pertaining to transmitters. Figures 4.

Semiconductors; Dielectrics; Luminescence; Solid State; Films

USSR

UDC   669.018.5

MAGNETOTRANSISTORS BASED ON FIELD GALVANO-MAGNETO-RECOMBINATION EFFECT

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 1, 1978 pp 34-35

LEVITAS, I. S., candidate in physicomathematical sciences, and RAGAUSKAS, A. V., candidate in technical sciences

[Abstract] Magnetotransistors are galvano-magneto semiconductor devices with electrically controllable magnetosensitivity. The feasibility of modulation or coding of magnetosensitivity without a significant change of the residual metrological characteristics of the device makes it possible to increase the efficiency of many devices and to create measuring systems and automation devices which possess completely new properties. The Kaunassk Polytechnical Institute imeni A. Snechkusa together with the Institute of Semiconductor Physics, Academy of Sciences, Lithuanian SSR, created a number of new magnetotransistors in which the field galvano-magneto-recombination (PGMR) effect is used. The principles of operation of a PGMP transistor with a metal-insulator-semiconductor structure are explained, and terminology in the field of the parameters of magnetotransistors is discussed. The dependences of the parameters on the magnitude of the magnetic field induction, the operating current, and the characteristics of the control of magnetosensitivity are shown. The metrological characteristics are presented of Type MT-1, -2,-3, and -4 PGMR transistors based on germanium which were produced at the Institute of Semiconductor Physics, Academy of Sciences, Lithuanian SSR. Figures 5; references 10: 7 Russian, 2 Czech, 1 Western.

ANALYSIS AND SYNTHESIS OF NONSTEADY LINEAR SYSTEMS BY THE OPERATOR METHOD

MIKHAYLOV, F. A., TERYAYEV, YE. D., BULEKOV, V. P., TYKHEVICH, O. F., and KHADZHINOV, M. K., Moscow Aviation Institute imeni S. Ordzhonikidze

[Abstract] The theory of the Laplace transformation and the concept of the transfer function are applied to nonsteady linear systems with real coefficients and a periodic input signal. The unilateral left-hand Laplace transformation is considered next, and the concept of the transfer function is developed so as to include possible structural modifications (series, parallel, and cyclic) of a system which facilitate its analysis and subsequently synthesis. This left-hand Laplace transformation is, finally, applied to a nonsteady discrete system. The paper was recommended by the Moscow Aviation Institute imeni S. Ordzhonikidze. Figure 1; references 27: 17 Russian, 10 Western.

ELECTRICAL ENGINEERING

Electrical Engineering Equipment and Machinery

USSR   UDC 62-83(47).001.1

GENERAL TASKS IN THE DEVELOPMENT OF ELECTRIC DRIVES IN THE SOVIET UNION

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 77 pp 24-27

YUN'KOV, M. G., director, VNIIelektropriboda [All-Union Scientific Research,
Planning, and Design Institute for Automatic Electric Drive in Industry, Agri-
culture, and Transportation]

[Abstract] Automation of industrial electric drives has for several years
been a major goal successfully pursued by the electric drives industry.
Drives are already available ranging from small ones below 10 kW to large
ones above 12,000 kW. A main problem here is the diversity of applications
and the ever increasing complexity of technological processes which these
drives control. The tasks involve proper conversion, distribution, and utili-
zation of energy, which are particularly difficult when the performance is
determined not only by independent system parameters but also on dependent
ones and external factors often statistical in nature. Accordingly, the
trend is now toward the use of control computers and multilevel automatic
controls. As for the drives, a major development has been the application of
thyristors in connection with variable-frequency a.c. sets where conventional
d.c. machines are not practical ($Pn > 4 \cdot 10^6$ kW·rpm). Another important devel-
opment are linear induction motors, particularly attractive for use in high-
speed (400 km/h) transportation. As for the drive controls, printed-circuit
technology has made a significant contribution to the overall system feasibili-
ty in terms of manufacturability and installation. Further improvement of
efficiency and compatibility as well as further search for new easily converti-
ble energy sources continue as major tasks for the industry.

USSR   UDC 621.31:62-213.34

PRODUCTION OF ELECTRICAL EQUIPMENT FOR ELECTRIC DRIVES USED BY THE MINING
INDUSTRY AND UNDER EXPLOSION HAZARDS

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 77 pp 36-40

BYKOV, A. I., general manager, Donets Nongovernmental Organization "Explosion-
proof Electrical Equipment"

[Abstract] Upgrading the explosion-proof equipment for electric drives used
by the mining industry is essential, considering that the output of this in-
dustry has already increased by 70 percent during the tenth Five-Year Plan.
Electric motors of small and intermediate sizes used by this industry oper-
ate now from 380 or 660 V, very large ones from 6 kV. Improvements in the
production of such drives now underway include upgrading of existing models,
developing new models with still better performance characteristics, upgrad-
ing of accessories such as starters, switches, and protective devices, com-
paction of the controls, and application of more powerful energy sources.

Coal mining is the main target, mining of ferrous and nonferrous ores being next in importance. The trend is toward a more extensive use of general-purpose and transportable drives. The introduction of thyristors has greatly enhanced the design of new drive and control systems. One of the goals of the industry is to deliver electric machinery to other CEMA member countries for their mining needs, which requires a joint standardization of motor ratings, dimensions, and explosion-proof features. Cooperative efforts in this direction are underway. Figures 3; references 4 (Russian).

IMPROVEMENT OF SPECIFIC PROCESSES IN THE MANUFACTURE OF ELECTRICAL MACHINES
ON THE BASIS OF THEIR STANDARDIZATION AND UNIVERSALIZATION

KOSTROMIN, V. G., candidate in economical sciences, YEPIFANOV, V. S. and
DAGAYEV, V. A., candidates in technical sciences

[Abstract] All operations involved in the manufacture of electrical machines
have been classified into twenty basic process groups and the latter categorized according to the degree of plant specialization. An operational and
economic analysis of specific processes, coil assembly and insulation ranking
foremost in significance, has revealed where improvement is possible in terms
of better plant utilization on the basis of more standard and universal procedures.

PROBLEMS IN GENERATOR DESIGN AT THE WORLD ELECTRICAL ENGINEERING CONGRESS
(MOSCOW, JUNE 1977)

GLEBOV, I. A., academician, DANILEVICH, YA. B., and MAMIKONYANTS, L. G., drs
in technical sciences

[Abstract] The topics covered by Section 1: "Generation of Electric Energy"
at the World Electrical Engineering Congress in Moscow, June 1977 were:
trends in the development of electrical engineering apparatus, increase in
the power ratings of turbogenerator units, improvement in the performance reliability of turbogenerators, improvement in the cooling of turbogenerators,
improvement in the mounting of stator coils, improvement in the design of end

laminations for the stator stack, turbogenerator performance under special conditions, developments in hydrogenerator design, hydrogenerator cooling systems, and unusual features of hydrogenerator construction, problems in generator-motor sets starting, in excitation, and in regulation. References 25: 8 Russian, 3 German, 14 Western.

METHODS OF TESTING INSULATORS SUBJECT TO NATURAL CONTAMINATION AND HUMIDITY

MERKHALEV, S. D., POPKOV, V. I., candidates in technical sciences, REYN, B. M., and UDOD, YE. I., engineers. NIIPT-Kievenorgo [Scientific-Research Institute of Direct Current--Kiev Trust of the Power System Management]

[Abstract] Laboratory methods of testing insulators are proposed with simulation of the operating voltage but with fewer test samples than in conventional methods, and without the need for high-voltage protection. The test stand is supplied either from a separate high-voltage source such as a transformer, or from busbars through a separate circuit breaker which ensures repetitive clearing of short circuits (10 times a day or 100 times in a year). The insulators are stacked into a column and selectively shorted through a flexible conductor and a flashover recorder. A smaller number of unshorted insulators requires a lower test voltage, but then the accuracy of determining the voltage gradients decreases. One method is based on measuring the average discharge voltage gradient, another method is based on measuring the maximum withstood voltage gradient. These gradients are measured at each level of contamination and humidity. Figures 3; tables 2; references 10: 3 Russian, 7 Western.

PERMISSIBLE RATES OF VOLTAGE RECOVERY FOR SERIES VNV CIRCUIT BREAKERS

BUYNOV, A. L., engineer, BYSTRUYEV, A. K., candidate in technical sciences, and PUZYRIYSKIY, G. S., engineer. VEI imeni V. I. Lenin--NITs VVA [All-Union Electrotechnical Institute imeni V. I. Lenin, Scientific Research Center of High-Voltage Equipment]

[Abstract] In connection with the development of series VNV air circuit breakers, rated for 40 kA at 330, 500, or 750 kV, a study was made to determine the dependence of the permissible voltage recovery rate (linear) on the current interrupting capacity. Experiments were performed with an artificial two-frequency scheme and parallel superposition of currents (250 Hz on the 50 Hz line frequency) in the voltage circuit. The test data fit the basic relation $\frac{dV}{dt} I^{0.6} = 12.6n =$ const, where dV/dt is the linear rate of voltage rise (kV/us), I is the effective current (kA), and n is the number of gaps in the circuit breaker. The reliability, the shunting requirements for protection against excessively high-voltage recovery rates, and the short-circuit characteristics were also evaluated in this study. Figures 4; table 1; references 6: 4 Russian, 1 German, 1 Western.

SENSITIVITY OF CURRENT PROTECTION DEVICES FOR ELECTRIC MOTORS

KLETSEL', M. YA., engineer, Pavlodar Industrial Institute, and POLYAKOV, V. I., dr in technical sciences, Ural Polytechnic Institute

[Abstract] The sensitivity of protective current devices for electric motors to interphase shorts is analyzed and, on the basis of simple relations, a determination is made as to what part of the stator winding is actually protected by current relays. The analysis and subsequent calculations show under what unusual conditions a two-relay or a single-relay protection system for synchronous and induction motors can be installed without checking its sensitivity. Inasmuch as under usual conditions such a protection appears quite ineffective, there is a need for expanding the use of differential protection schemes and for developing new more sensitive protection devices. On the other hand, taking the magnetization current properly into account will in many cases render a single-relay protection suitable. Figure 1; references 5 (Russian).

ENGINEERING DIAGRAMS FOR CHARTING THE OPERATION OF SWITCHING DEVICES IN PRO-
TECTIVE RELAYING SYSTEMS

SVIRIDOV, V. G., GRITSENKO, I. P., RUFOVA, L. N., RUDENKO, M. F., IZRAILEV-
SKIY, N. L., and TESLENKO, A. K., engineers. Dontekherergo-Donbassenergo
[Donets Technical Trust of the Power System Management. Donets Basin Trust
of the Power System Management]

[Abstract] As an aid for improving the organization and the reliability of
ever more complex protective relaying and automatic control in power systems,
engineering diagrams have been developed to describe the functioning of com-
ponent devices and their sequence of operation. These diagrams are combined
with a special terminology and symbols. The meaning and the advantages of
such diagrams are explained in two basic situations: a flow chart according
to which a typical differential relaying system is actuated and a flow chart
according to which a fault in a relay protection circuit is cleared. These
diagrams are found particularly useful for 500-750 kV substations or electric
power plants with complex primary connections and heavy relaying on a single
interconnection. Figure 1.

A SET OF INSTRUMENTS FOR CHECKING TRANSISTORIZED PROTECTION DEVICES

BORISOV, V. A., VOLYNTSEV, F. I., candidates in technical sciences, and
GRIGOR'YEV, V. G., engineer. Chuvash State University

[Abstract] A set of instruments has been developed for adjustment and pre-
ventative checking of series M transistorized protective devices. Model
UPTZ-2 is a nonautomatic special-purpose tester for checking the performance
of all functional components. It consists, essentially, of a commutator, a
set of test signal generators for various operating modes, an indicator with
or without a matching circuit, and a set of meters. Model UPTZ-3 is intended
for testing of protection systems by simulation of the operating modes. Mod-
el UPTZ-4 is intended for testing the insulation between component circuits.
The three instruments weigh 30, 2, and 22 kg, respectively. The complete
testing time of one protection unit is 20, 2, and 5 min, respectively. Fig-
ures 6; table 1; references 3 (Russian).

USSR   UDC   621.316.933.3.027.8(282.242.4)

SERIES RVMG 110 AND 220 kV DIODE DISCHARGERS FOR COLD-CLIMATE DISTRICTS

VITKIN, A. L., engineer, ROZET, V. YE., candidate in technical sciences, and
TABARDANOVA, M. P., engineer. NPO "Elektrokeramika"--NIIPT [Nongovernmental
Organization "Electroceramics," Scientific Research Institute of Direct
Current]

[Abstract] Diode dischargers with magnetic quenching have been developed for
operation at 110 and 220 kV in cold climates, specifically at the Kolyma and
Vylyuy Hydroelectric Power Plants. Their design has been standardized to the
fullest extent possible, to match the regular existing RVMG series. The ef-
fect of heating in the shunt resistors has been considered, as well as the
effect of low temperatures on the spark-gap characteristics, on both series
and parallel resistors, and on the mechanical strength of porcelain caps.
Accordingly, the construction meets the mechanical requirements at tempera-
tures down to -60°C (-64°C intermittently) and wind velocities up to 40 m/s.
The dischargers have also been successfully tested for their electrical char-
acteristics according to applicable standards: breakdown voltage (350 kV
nominal, dry or wet) and voltage-time curve with a pulse factor of 0.6 with-
in the dip range of this curve). These dischargers should be suitable for
installation in the Northernmost and Far Eastern districts. Figures 3; ref-
erences 2 (Russian).

USSR   UDC   661.728:621.314.21

USE OF CELLULOSIC MATERIALS IN TRANSFORMER MANUFACTURE

KORITSKIY, YU. V., candidate in technical sciences, MIRONOVA, A. M., SOKOLOVA,
S. L., VAYSFEL'D, V. P. and BALYASNIKOVA, V. V., engineers

[Abstract] A new grade M cellulose board for transformers, with a 30 percent
cotton content, is compared with the conventional grade A material, as well
as with the Spaulding (USA) cotton-cellulose grade T material, with respect
to GOvernment STandard 4194-68 and Technical Specification 81-04-406-76 char-
acteristics. It is found to be at least equal to both, while excelling in
oil impregnability and corona resistance. In a further study the effect of
various transformer-grade papers and cloths on the degradation of transformer
oil in grade KMTU-080 melamine paper has been found to be more heat resistant
than the conventional grade KVU-080 paper and grade EKTM Kraft paper to be
more oxidation resistant as well as electrically and mechanically stronger
than grade LKhMM-105 varnish cloth. An appropriate substitution of materials
for insulating transformer coils is, therefore, recommended. Figure 1;
tables 6; references 3 (Russian).

USSR

ELECTRICAL ENGINEERING IN HOMES

MIRONOVA, N. A., engineer

[Abstract] Developments in consumer electrical engineering are oriented toward the solution of major social problems such as transforming the life style to a higher level of culture and well-being. Accordingly, their main thrust is in the area of labor saving and comfort at home. This has been the aim since the Soviet Government came to power, even during the difficult 1920's. The first washing machine and vacuum cleaner were produced in 1939; 50 different electric motors for various home appliances were already manufactured in 1945. Production has increased tremendously since, in both volume and diversity. Electrical appliances now mass produced range from water heaters and air conditioners to over 600 different lamps, and also include domestic voltage stabilizers. Model and line changes occurred last during the ninth Five-Year Plan, lamps are changed every 3 years. Progress in the electrical appliance industry is based on application of new materials and processes as well as production techniques, usually adopted from "heavy" industry, with each new line incorporating the latest breakthroughs. A typical example is the replacement of oil-filed radiators (heating elements) "dry" radiators with current-conducting film coatings, and consideration of heat pipes as the next step. Another example is the new assortment of cords with latest safety features to match any appliance. The main trends in consumer electrical engineering are better safety and reliability, also miniaturization for a more economical use of materials and a more efficient use of living space. A typical example incorporating such features is a complete electrically operated kitchen.

EXPERIMENTAL FEASIBILITY STUDY OF A SEA WAVE POWER PLANT

DENISENKO, G. I., Corresponding Member, Academy of Sciences, UkrSSR, FEDOSENKO,
L. P. and SHCHERBAKOV, V. V., engineers, Kiev Polytechnic Institute

[Abstract] A 1 kW experimental power plant was designed at the Kiev Poly-
technical Institute and built for operation under Black Sea conditions with
an average wave length of 10-30 m and 1.2-2.5 m high with a period of 3-7
sec. The size of the power unit is $1\times0.6\times0.6m^2$, the system pressure reaches
30 atm, and the optimum turbine speed is 1000 rpm. This plant was tested in
the sea 120 m away from the Skadovska beach. The electric generator was
loaded with a bank of 200 W dome lamps. The sensitivity threshold (at which
the turbine began to rotate) was found to correspond to a hydraulic pressure
equivalent to 15-18 cm^3/sec or a 0.2 m high and 7-8 m long wave. The gener-
ated power was found to be proportional to the wave height. Figures 2.

PRESENT STATUS OF RESEARCH IN AND FUTURE OUTLOOK FOR DIRECT CONVERSION OF
OTHER FORMS OF ENERGY TO ELECTRICAL

LIDORENKO, N. S., Corresponding member Director, All-Union Scientific Re-
search Institute of Electric Current Sources

[Abstract] Most research in direct energy conversion has either reached the
scientific stage or already passed into the more practical engineering design
and manufacture stage. Devices are available for direct conversion of other
forms of energy to electrical which include photoelectric solar cells with
an efficiency up to 20 percent, solid-fuel and liquid-fuel thermoelectric
generators delivering up to 1 kW, thermoelectric cells operating with tempera-
tures from room level to 1000°C and delivering from a few microwatts to a few
hundred watts, electrochemical cells and storage batteries (mercury-zinc),
and electrochemical generators operating on either natural fuel or synthetic
oxidizer-fuel systems. The main thrust of further research is toward lower-
ing the cost, increasing the output, and improving the reliability, aimed at
wider areas of application such as in transportation and communication (e.g.,
data processing, automatic control, measurements). Figures 2.

USSR

PROBLEMS AND PROSPECTS OF CREATING THERMONUCLEAR POWER PLANTS

VELIKHOV, YE. P., academician, USSR, and KINTNER, YE., USA

[Abstract] An abbreviated version is given of the report on the development status of thermonuclear power plants presented at the World Electrical Engineering Congress (WELC) held in Moscow from 21 to 26 Jun 77. Scientists working in the area of accomplishing a controllable thermonuclear reaction are more than ever convinced that practical application of fusion reactions will be achieved in this century. Thermonuclear energy will be safe and inexpensive. Substantial progress has been made in studies of the physics of the reaction. Two major problematic areas are plasma confinement and heating of the plasma. A density-times-energy-confinement-period figure of about 3×10^{13} $cm^{-3} \cdot s$ has been achieved in experiments using experimental reactors in the USSR and USA. This figure is in principle sufficient for successful operation of a hybrid reactor, and approximately an order of magnitude higher is needed for a pure reactor. It has been demonstrated that it is possible to create a reactor with high power density when employing supplementary heating methods. Other experimental results have shown that it is possible to control the form of the pinch, resulting in increased pressure, and to separate the plasma column from the wall with a rising longitudinal field. In a thermonuclear reactor the plasma must be heated to 50 to 70 million degrees Celsius, or five to seven kiloelectronvolts. For this, Soviet industry has developed excellent microwave gyrotron generators. It has been shown that the plasma can be heated with strong high-frequency r-f emission, which is a technique which might prove to be a competitor of the technique of injecting neutral beams. Existing units are being modernized and their parameters improved. It is expected that by the beginning of the 80's it will be possible to obtain in experimental reactors a plasma with parameters sufficient from the physics viewpoint for creating full-scale reactors and that the necessary equipment will have been created for making them. Proceeding to the next step of making large units capable of producing significant quantities of energy is contingent upon arriving at a hydrogen plasma with reactor parameters and making studies of it by 1979-1980 and on obtaining a considerable amount of thermal energy by 1982. Two units capable of achieving these goals are under way in the USA and design work is being done in the USSR and other countries.

USSR   UDC 621.311.25:621.039.004.17.001.24

PRECISE CALCULATION OF THE DESIGN EFFICIENCY OF ATOMIC ELECTRIC POWER PLANTS

PAVLOV, V. P., candidate in technical sciences, and PANEVSKI, I. K., engineer.
DNI-NIPPES "Energoproyekt" [Expansion Unknown] Sofia, Bulgaria

[Abstract] A method of calculating the design efficiency of atomic electric
power plants is shown which, unlike conventional methods, reflects diurnal as
well as seasonal and annual variations of external factors. Accordingly, the
specific gross heat consumption of a turbogenerator set appears here not as a
figure guaranteed by the manufacturer but as a function of the vacuum inside
the condenser at various load levels. It is in this way possible to take
into account the temperature of the cooling water and also the plant dynamics.
References 3: 2 Russian, 1 German.

USSR   UDC 621.311.25:621.039.004.65.001.57

SIMULATION OF FAULTS IN ATOMIC ELECTRIC POWER PLANTS WITH WATER-COOLED WATER-
MODERATED REACTORS

MURADYAN, S. G., candidate in technical sciences. NPO "Energiya" Minerergo
SSSR [Nongovernmental Organization "Energiya," USSR Ministry of Power Engin-
eering and Electrification]

[Abstract] The method of hybrid simulation is applied to an analysis of
faults in atomic electric power plants with water-cooled water-moderated re-
actors, steam generators, and circulation loops. The equations of neutron
kinetics and heat transmission within the active zone, the equations of heat
transmission within a steam generator unit, and the equations of transport
delay along circulation piping are accordingly first represented on an analog
computer and then solved numerically on a digital computer. The advantage of
this method is the possibility of plant operation with the aid of fixed ana-
log model structures and small digital control computers. The introduction
of variable temperature scale factors facilitates the analysis of startup and
shutdown conditions as well as of faults constituting departures from nominal
performance levels. Figures 4; references 8: 7 Russian, 1 Western.

USSR

MHD ENERGY CONVERSION

SHEYNDLIN, A. YE., academician, USSR, and DZHEKSON, V. D., doctor, USA

[Abstract] An abbreviated version is given of the report on MHD energy conversion delivered at the World Electrical Engineering Congress (WELC) held in Moscow from 21 to 26 Jun 77. A brief history is given of the development of MHD generators, with emphasis on the fact that the USA has demonstrated that an MHD generator can operate on coal. The operating principle of an MHD generator is discussed, noting that with the same consumption of fuel an MHD unit affords 50 to 60 percent greater efficiency than the ordinary steam turbine plant. A brief description is given of open-cycle and closed-cycle methods of operation and diagrams are shown of the main components of an MHD system. The most attractive MHD system consists of an MHD generator combined with a steam turbine plant at its outlet, whereby both halves of the system are joined by a regenerative heat exchanger which gets its heat directly from the gases leaving the MHD channel, thus providing maximum overall efficiency. Because MHD generators consist mainly of non-moving parts, high reliability is ensured at high temperatures. In addition, in coal-burning units discharge of sulfur compounds into the atmosphere is reduced considerably because the alkali additive captures the sulfur. Development of MHD systems in the USSR is traced briefly. A unique inverter unit has been created which makes it possible to transform direct current into alternating while at the same time carrying over the power tapped from the MHD generator into the external power line. A brief history of development of magnetohydrodynamics in the USA and other countries is also given. The Faraday, Hall, and diagonal methods of charging an MHD generator are illustrated. Studies made of coal-burning MHD generators at the University of Tennessee have demonstrated that the slag film which forms on the walls of the channel can protect the electrodes from erosion with practically no longitudinal current loss. Inverters and superconducting magnets are discussed briefly. The necessity for electrical insulation of the various components is stressed. Mention is made of the uniquely designed superconducting magnet system being assembled at Argonne National Laboratory. This system is scheduled to be tested in the bypass circuit of the U-25 plant in the USSR, under the terms of the Soviet-American cooperative agreement. Work has begun in the USSR on designing the main industrial plant of an MHD power plant with a capacity of about 500 MW. Construction will be completed in the first half of 1980. This first-generation MHD power plant will make possible a fuel savings of approximately 25 percent with but a slight increase in capital investment per kilowatt of net power. The savings in fuel will make it possible to pay off the extra capital investment in 4.5 to five years. CDIF plant being developed in the USA will be the prototype of coal-fueled MHD power plants. MHD plants are thought to be a highly promising method of producing electrical energy. Figures 3.

THE PHASE OF THE OUTPUT SIGNAL OF A TWT WITH SIMULTANEOUS APPLICATION OF BASE
AND DOUBLED FREQUENCY SIGNALS TO THE INPUT

MALIVANCHUK, V. I., DENISOV, A. I., and OLEKH, N. YA.

[Abstract] Based on machine calculations using nonlinear equations for a TWT
operating in the two-frequency mode, the influence of the amplitude and phase
of the second harmonic at the input of the tube on the phase of the output
signals at the base frequency is analyzed. The analysis is performed for
various operating modes of the tube. It is shown that in certain modes the
phase of the output signal at the base frequency depends essentially on the
level and phase of the second harmonic at the input of the TWT. The second
harmonic has the least influence on the phase of the output signal in maxi-
mum gain modes in the area where the phase of the second harmonic at the in-
put in the TWT corresponds to the maximum efficiency. Figures 5; references
7: 5 Russian, 2 Western.

SELECTION OF PARAMETERS OF HETEROGENEOUS TWO-MODE TWT

VINOKUROVA, T. V., and PEREKUPKO, V. A.

[Abstract] Problems are discussed related to the selection of the parameters
of a high frequency circuit for a TWT with predetermined distribution of phase
velocity of the signal wave over the length of the delay system. An equation
is derived relating the parameters of the delay system (spacing, mean radius
of spiral) in various sectors, allowing near optimal parameters to be select-
ed, as is required in the stage of planning of such a device. Figures 2;
references 3 (Russian).

SELECTION OF THE DIMENSIONS OF OCTAVE HELICAL TWT

MALIVANCHUK, V. I., OLEKH, N. YA., and RETINSKAYA, A. S.

[Abstract] Based on numerical calculations using the equations from the non-
linear theory of TWT in the multifrequency mode, the influence is studied of
the diameter of the helix 2a and screen 2R on the efficiency and level of the
second harmonic in an octave helical TWT. Calculations were performed on a
BESM-4 computer for 64 "electrons" with an integration interval of 0.1. It
is determined that in developing an octave helical TWT, the diameter of the
channel should be selected on the basis of the condition $\gamma a = (1.6-1.7)$ for
the middle frequency of the range, while the screen should be either quite
close to the spiral ($R/a \leq 1.2$) or should be some considerable distance from
it ($R/a > 3$). Figure 1; references 6: 4 Russian, 2 Western.

STUDY OF A VOLTAGE-TUNED MAGNETRON IN THE SYNCHRONIZATION MODE

AL'TSHULER, YU. G., and DYATLOV, YU. V.

[Abstract] The results are presented of an experimental study of synchroni-
zation of a voltage-tuned magnetron, and problems are discussed related to
limitation of the synchronization band, constancy of the output power level
and the gain, analyzing the magnetron as a regenerative amplifier. A voltage-
tuned magnetron can be used in the synchronization mode as a regenerative am-
plifier with a gain on the order of 20-25 dB and as an oscillator in phase-
controlled systems. The synchronization mode can be used for measurement of
the Q of a load in the dynamic mode. Figures 5; references 3: 2 Russian, 1
Western.

OPTIMAL GROUP AND MAXIMUM EFFICIENCIES OF KLYSTRONS WITH DISTRIBUTED INTER-ACTION

FILIMONOV, G. F.

[Abstract] This theoretical work is dedicated to an evaluation of the maximum efficiency of klystrons with distributed interaction at various levels of Coulomb forces in the device, and an explanation of the conditions of optimal grouping of electrons. Conditions of achieving the maximum efficiency of klystrons with various perveances of the electron beam are studied. A comparison with ordinary klystrons is presented. The data presented show that a klystron with distributed interaction amounts to an instrument combining the features of a klystron and a traveling wave tube, achieving the efficiency of a klystron with grouping at maximum power output characteristic for a TWT. There are a number of advantages in comparison with ordinary klystrons: at low beam perveances, its optimal length is 1.5 times less than the optimal length of an ordinary klystron, with equivalent efficiency. At high space charge density, the efficiency of the klystron with distributed interaction is higher than that of an ordinary klystron. Figures 2; table 1; references 8: 5 Russian, 3 Western.

A MEGAWATT RELATIVISTIC KLYSTRON WITH DISTRIBUTED INTERACTION

LOSHAKOVA, I. I.

[Abstract] A study is made of a klystron with distributed interaction consisting of a four-resonator grouper and an output section including a delay system in the form of a modified plane with rings. The grouper provides for a first harmonic level at the input to the end section of $I_1/I_0=0.70-0.4$, which is far from optimal. Even though most of the important parameters are displaced, the experimental data can be used in theoretical design work as beginning reference points. Figures 2; references 4 (Russian).

NONLINEAR THEORY OF RESONANT O-TYPE COUPLING ELEMENTS USING FAST CYCLOTRON WAVES

GRECHUSHKIN, K. V., STAL'MAKHOV, V. S., and SHCHEGOLEV, V. P.

[Abstract] An estimate is presented of the nonlinear properties of resonant coupling elements, and the possibility of their use for transformation of powerful input signals is investigated by solving the self-consistent problem. The study is based on a resonant coupling element, a so-called Cucchia resonator, placed in a longitudinal magnetic field. Electrons are intensively rotated by a transverse HF electric field, and the energy of the HF field is thus converted to electron rotation energy. A theoretical analysis of the interaction of the electromagnetic field with the electron flow in cyclotron resonance is presented. The process of absorption of the high frequency energy by the electron flow is studied. Analytic equations are produced allowing coupling elements utilizing fast cyclotron waves to be designed. It is demonstrated that resonant coupling elements cannot be as effective as coupling elements with distributed interaction, in terms of transmission of HF power from the line into the beam. Figures 2; references 7 (Russian).

POSSIBILITY OF PARAMETRIC GENERATION AND AMPLIFICATION OF ELECTROMAGNETIC WAVES AT FREQUENCIES HIGHER THAN THE PUMPING WAVE FREQUENCY IN ELECTRON STREAMS

KALMYKOV, A. M., KOTSARENKO, N. YA., and KULISH, V. V.

[Abstract] A new principle is suggested for active parametric upward frequency conversion in electron streams. Its essence is that the low frequency electromagnetic pumping wave propagating in the direction opposite to that of the stream of electrons can generate or amplify a high frequency electromagnetic wave and a slow space charge wave. The authors refer to an earlier work by G. R. Davis [Navy Researchers Develop New Submillimeter Wave Power Source, Microwaves, December 1976, p 12]. In the opinion of the authors, in the experiments of Davis, the process of active parametric upward conversion of the frequency analyzed in this article actually occurred. It is further noted that the same effect should occur if the slow space charge wave is replaced by a slow cyclotron electron wave. Reference 1 (Western).

INCREASE IN THE EFFECTIVENESS OF THE OPERATION OF DIFFRACTION RADIATION
OSCILLATORS WITH MAGNETIC FOCUSING

BALAKLITSKIY, I. M., VOROB'YEV, G. S., TSVYK, A. I., and SHESTOPALOV, V. P.

[Abstract] A change in the configuration of the focusing magnetic field in
the interaction space of the electron stream with the HF field of an open
resonator is used to establish experimentally the possibility in practice of
improving the effectiveness of operation of diffraction radiation oscillators.
The results of the study are presented in the form of graphs. New practical
possibilities are opened for increasing the effectiveness of operation of
these devices with magnetic electron stream focusing. The specific nature of
the trajectories of the electron stream in the interaction space of the de-
vice with a magnetic heterogeneity indicates the possibility of using thick
electron streams in these devices, eliminating the need for the additional
collector electrode. These oscillators are also less sensitive to adjustment,
significantly facilitating their use in electronic devices. Figures 3; ref-
erences 2 (Russian).

CALCULATION OF THE REDUCTION FACTOR FOR A HOLLOW RELATIVISTIC ELECTRON STREAM
IN A COAXIAL SCREEN

KATSMAN, YU. A., MOVNIN, S. M., and TREBICH, V. D.

[Abstract] An analysis is presented of the reduction factor for a hollow
electron stream enclosed between two coaxial cylindrical conducting electrodes.
The reduction factor is determined using a method based on solution of the
four-dimensional Poisson equation. In the calculation, it is necessary to
find the axial field component of the space charge. Experimental and calcu-
lated results agree satisfactorily. Figures 3; references 3: 2 Russian, 1
Western.

TECHNOLOGICAL BASIS OF COMPLEX MECHANIZATION OF PRINTED-CIRCUIT CARD PRODUC-
TION

TRUNTSEVSKIY, V. R., engineer

[Abstract] On the basis of technological premises discussed in the paper,
the Ryazansk Planning and Technological Institute worked out the technologi-
cal scheme of a mechanized process for producing printed-circuit cards and
the means of mechanization. A special feature of the scheme, which differs
from that operative at present during production of cards at plants of the
instrument building sector, is fulfillment of a number of operations on pro-
cessing lines which are unitized from individual unified modules in combina-
tion with devices provided to process the surface with the use of clearing
brushes. Eight forms of modules and the devices used as well as the techno-
logical operations which can be fulfilled on the unitized module lines are
identified and discussed. The Institute also solved the problem of mechani-
zation of the time-consuming manual operations for preparation of the surface
of printed-circuit card stock before application of electrodeposits, lac-
quering and application of protective technological coatings.

MECHANIZED TOOLS FOR SPREADING OF CONDUCTORS INTO BRANCHED BUNDLES

ADAYKIN, I. I., ISYANOV, N. S., PISAREV, V. A., RACHKIN, V. N., and TRIFONOV,
YE. F., engineers

[Abstract] An electrical digital control has been devised for spreading and
branching of conductor bundles of medium intricacy which make mechanization
desirable and are produced on a small enough scale to make automation unfeasi-
ble. The controlled mechanism operates from blueprints transcribed onto
punch tape on a coordinate table, with appropriate pushbutton actuation.
Figures 3.

WIRE ASSEMBLY BY TWISTING ON BREADBOARDS OF MICROCIRCUIT DEVICES

GREBENNIKOV, V. A., candidate in technical sciences

[Abstract] New wiring methods for integrated-microcircuit breadboards which
reduce the labor involved in conventional soldering or printing include twist
connections. A special tool has been developed for this purpose which makes
such joints directly at the integrated-microcircuit terminals, without damag-
ing the latter or the encapsulation. It carries a sufficiently large supply
of wire (50-100 m) for making joints in a single run without breaks, it also
combines the operation of wire cleaning (unilateral insulation stripping) with
twisting the wire pair into an insulator cap. This model BOZI twister makes
joints which are both reliable and disassemblable for rewiring. Figures 3;
references 9: 7 Russian, 1 German, 1 Western.

APPLICATION OF THE ELECTRON-ION TECHNOLOGY IN INDUSTRY

SAMKHARADZE, G. P., director, Scientific-Research Institute of Electron-Ion
Technology

[Abstract] Electron-ion technology is a typical case of a practical spinoff
of scientific-engineering research. This technology encompasses a wide range
of processes, from gas purification and dyeing to fractionation and even ore
enrichment. Such process require low-power high-voltage supplies and, since
recently, 1000 V -400 Hz transformers with rectified output as well as elec-
trostatic converters and short-pulse generators are available for these ap-
plications. Each particular process consists essentially of three main
stages: charging the particles, guiding their subsequent motion, and deposit-
ing them on the electrode to form an end product. Interesting developments
have been made in electrophoresis and powder deposition. Excellent results
have been obtained in metal cladding of plastics, protective coating of sur-
faces, separation of quartz permatite for porcelain insulators, electrostatic
fasteners, air filtration with dust abatement, and various dyeing processes.

ORGANIZATION OF SECTION FOR PHOTOMASK PRODUCTION

KOSTAN'YAN, M. G., engineer

[Abstract] The paper discusses the successful fulfillment of a complex of operations with respect to the development and production of photomasks for integrated circuits. This depends on the solution of a number of problems, the most important of which are: choice of production accommodations, which satisfy hygienic and climatic requirements; determination of the composition of special technological equipment and fitting out of a section with it; choice of a technological system; and availability of special materials and reagents. A detailed diagram is shown of the assignment of accommodations and the makeup of equipment for a model section for photomask production. The individual items shown in the diagram are explained. Figure 1; references 2: 1 Russian, 1 possibly East German.

Power Systems

DYNAMICS OF URBAN ELECTRIFICATION DEVELOPMENT

SHCHEGLOV, A. P., engineer.   Leningrad Cable Network

[Abstract] The general worldwide trend in urban electrification is toward higher generation voltages with fewer transformation stages. In the Soviet Union existing 6 kV cables are being gradually replaced by 10 kV ones, 110/10 kV becoming the standard voltage rating of electric power networks for Kiev and all new metropolitan districts. This trend necessitates developments in cable as well as substation design and reliability. The use of aluminum conductors and cross-linked polyethylene insulation is steadily expanding, there is a greater need for cathodic protection, and higher-grade steel and sealing compounds are used for substation transformers. Still timely are the problems of energy losses, economy, and permissible voltage fluctuations. Some basic statistics pertaining to equipment installation and operation in Moscow, Leningrad, Minsk, Kiev, and Riga are compared with those characterizing major Eastern European, Western European, and U.S. cities. Tables 3.

VOLTAGE RECOVERY ON THE FAULTED PHASE OF UNIT GENERATORS UPON QUENCHING OF THE GROUNDING ARC

VAYNSHTEYN, R. A. and GOLOVKO, S. I., engineers. Tomsk Polytechnic Institute

[Abstract] A unit generator with an isolated neutral is considered and the voltage recovery process, on the faulted phase, after quenching of the grounding arc is analyzed. The physical model consists of the arc, two transformer banks with at least the neutral on the high-voltage side grounded, capacitors, and leakage resistors. The circuit parameters of this model are established according to the theory of dimensional similarity and basic transformer equations. With the product of phase capacitance and equivalent short-circuit transformer resistance not larger than $1.27 \cdot 10^{-3} \text{F} \cdot \Omega$ transformer saturation caused by the aperiodic current caused by grounding fault appreciably decreases the voltage recovery rate on the faulted phase, when arc quenching occurs during the first, third, fifth, ... zero-crossover of the fault current (while the aperiodic current has not yet decayed). From the standpoint of arc quenching, decreasing the voltage recovery rate is most important during the first quenching half-period and in systems with the given relation of parameters, and therefore, transformers facilitate arc quenching. Figures 4; table 1; references 5: 4 Russian, 1 Western.

USSR   UDC   621.313.322-82.004.67

CENTRALIZED ATTENDANCE OF HYDROELECTRIC POWER PLANTS

Moscow ELEKTRICHESKIYE STANTSII in Russian No 1, Jan 78 pp 52-57

KOZHEVNIKOV, N. N., candidate in technical sciences. ORGRES [State Trust for the Organization and Rationalization of Regional Electric Power Plants and Networks]

[Abstract] A rational degree of centralization, according to cost and administrative criteria, as well as means of achieving it are considered with regard to interconnected hydroelectric power plants. The factors under consideration in centralizing the attendance of power plants include all control operations, general overhauls of plant buildings and equipment, general overhauls of turbine-generator sets and accessories, and in-service attendance. An organizational structure is developed and, for illustration, specifically applied to the complex of Kuban Hydroelectric Power Plants and the complex of Zemo-Avchala Hydroelectric Power Plants. The principle can also be applied to complexes of thermal electric power plants. Figures 3; table 1; no references.

USSR   UDC   621.315.001.2

TRENDS IN THE DEVELOPMENT OF ELECTRIC POWER TRANSMISSION

Moscow ELEKTRICHESTVO in Russian No 12, Dec 77 pp 27-32

LIBKIND, M. S., dr in technical sciences, and SOKOLOV, N. N., candidate in technical sciences. Moscow

[Abstract] Progress in electric power transmission is measured in terms of line capacity at the minimum possible loss. Electric power is essentially, and probably will be to the end of this century, transmitted over metallic conductors. Displacement and convection currents will not become feasible means of electric power transmission for the next 20-30 years. Under study in the Soviet Union are 1150 kV overhead lines capable of transmitting 2.8 times more power than existing up to 750 kV lines, namely 11 million kW over 400-500 km long distances and 3 million kW over 2000 km long distances. New techniques are also sought for underground lines, namely gas insulation of cables and superconductors with or even without cryogenic cooling. Because overhead or underground a.c. lines require power-factor correction, d.c. lines are also under consideration. The transmission range of any line is usually limited by economic factors and available alternatives. The goal is a capability of over 12 million kW over distances up to 4000 km. Nonconventional generators, not electromechanical ones, reaching tens of million kilowatts per unit are foreseen by the turn of the 21st century. References 10: 5 Russian, 5 Western.

PRINCIPLES AND TECHNICAL CHARACTERISTICS OF CONTROLLED AUTOCOMPENSATING
ELECTRIC TRANSMISSION LINES

ASTAKHOV, YU. N., VENIKOV, V. A., POSTOLATIY, V. M., and CHALYY, G. V., Moscow-Kishinev

[Abstract] The equations of an autocompensating electric transmission line, overhead or underground, are derived on the basis of the equivalent circuit diagram. The design and performance characteristics are analyzed for various possible phase configurations. The distinguishing feature of such controlled transmission lines is the means of establishing a phase shift between voltages applied to adjacent phases and regulating it continuously or discretely, with a fixed phase shift of 120° or 180°, for instance, as another alternative. Such a line consists, generally, of two three-phase networks, including terminal transformers, reactors, compensators, a reactive power source, phase regulators, circuit breakers with spark gaps, and necessary control devices. Technical data for five controlled autocompensating high-voltage (220/220, 330/330, 500/500, 750/750, and 1150/1150 kV) electric transmission lines are shown and further trends in their development are indicated. Figures 7; table 1; references 6 (Russian).

EXPERIENCE IN OPERATING 750 kV ELECTRIC TRANSMISSION LINES AND SUBSTATION

MOSKALEVSKIY, YU. P., engineer. Dnepropetrovsk System of High-Voltage Electric Networks

[Abstract] The Dnepropetrovsk 750 kV network includes the 226-km long Donbass-Dnepr line, the 3433-km long Dnepr-Vinnitsa line, and the "Dneprovskaya" substation. No major structural damage has occurred during service since 1971. The few maintenance problems are fracture of glass isolators, up to 1.453 percent of which have to be replaced after three years, redesign of guy ropes with necessary clearances, inadequate hermetization of reactor and autotransformer leads under heavy bending loads, which has caused leakage and necessitated three shutdowns, and jamming of circuit breakers in the "open" position. Otherwise, all the equipment is entirely satisfactory. The manufacturers ought to improve their predelivery inspection. Procedures and equipment must soon be available for routine overhauls. The personnel protection is adequate in terms of shielding structures, but there is a shortage of protective garments.

SYSTEM OF EMERGENCY CIRCULATORY UNLOADING OF 110 kV NETWORKS DURING FAULTS
BY MEANS OF 750 kV AUTOMATIC FAULT PROTECTION EQUIPMENT IN THE SOUTHERN
INTEGRATED POWER SYSTEM

BUSLOV, L. I., KLIMENKO, G. A., SHESTOPALOV, V. N., candidates in technical
sciences, GURARIY, M. I., LAPITSKIY, YU. S. TUVARZHIYEV, V. K., TSYGANKOVA,
L. G. and SHEYNERMAN, G. F., engineers. Institute of Electrodynamics, Acad-
emy of Sciences, Ukrainian SSR; Ukrainian Division, "Energoset'proyekt" [All-
Union State Planning, Surveying and Scientific-Research Institute of Power
Systems and Electric Power Networks]

[Abstract] Selective emergency unloading of a power network by remote con-
trol through special-purpose communication channels can be difficult because
of the many different distances involved. Selective emergency unloading of
a power network by radio communication can also be difficult because of the
low noise immunity. A circulatory emergency unloading system for the 750 kV
southern integrated power system was developed at the Institute of Electro-
dynamics, Academy of Sciences, UkrSSR. The system transmits audio signals
along power distribution lines and does not require any processing equipment.
The principal components of the system are high-voltage controlled rectifiers
with series resistors. Adjustment of the firing angles makes possible can-
cellation and enhancement of harmonics, which results in a current spectrum
very different from the generally white noise spectrum. Such spectra of
"disconnect" and "connect" signals are presented. The circulatory emergency
unloading system is connected across the phase voltage at the 110 kV busbars
in the pilot substation with 2 X 200 MVA autotransformers. The controls oper-
ate with frequency signals and appropriate logic. Figures 2.

ESTIMATE OF VULNERABILITY TO DAMAGE AND ANALYSIS OF THE RELIABILITY OF SIX
TO 10 kV NETWORKS UTILIZING THE M-222 COMPUTER

KODITSA, V. P., KOPANSKIY, A. I., MIKHAYLOV, A. A., TERESHKO, O. A., and
URSAKIY, F. S., engineers, Moldglavenergo [Moldavian Main Power Administra-
tion], Kishinev

[Abstract] A brief description is given of an automatic system for gathering
and statistical analysis of information on disconnections in six to 10 kV
networks, introduced at Moldglavenergo in 1974 for the purpose of developing
effective measures to increase their reliability. A set of programs developed
by the Moldavian Division of the Sel'energoproyekt [Rural Electrification

Planning] Institute makes it possible to estimate the following: overall technical indicators of damage and systematic disconnections; technical indicators of damage to aerial transmission lines and six to 10 kV equipment and circuit breakers; and technical indicators of power transformers with maximum voltage of six to 10 kV. Raw data are compiled by regional controllers, who record disconnections in a journal and mail the results monthly to the rural electrification service. The information obtained is punched at the computer center of Moldavenergo and is recorded on magnetic tape. Computer runoffs are distributed to power system enterprises. A special coding system has been developed to achieve standardization of documentation, raw data, and analysis sheets. In the record journal is recorded a three-digit number indicating (1) the disconnected component (line, line section, transformer), (2) functioning of the relay protection circuit and automatic devices, and (3) the nature of the problem and the reason for and type of damage. Also entered are the length of lines cut off, the number of transformers out and their capacity, the number of damaged components, the date and time of the disconnection, and the date and time of restoral of service. The system's software is designed for the M-222 computer and is written in Fortran-SAPRES. Slight changes in the program make it possible to analyze reliability in 0.4 kV networks. Record journal entries require only one line. The factor indicating interruption of service in distribution networks of Moldglavenergo has been reduced from 0.66 in 1972 to 0.3 in 1976 because of introduction of this system. The maximum number of peak-load power stations the system can handle is 14. Figure 1.

USSR

LAYOUT OF THE 6.4 MILLION kW BEREZOVKA STATE REGIONAL ELECTRIC POWER STATION

Moscow ENERGETIK in Russian No 10, Oct 77 p 15

[Unsigned article]

[Abstract] Specifications for the Berezovka GRES [State Regional Electric Power Station] prepared by the Rostov Division of Teploelektroproyekt* recommended that all eight 800-MW power plants be installed in tandem in a single main building. This matter was discussed by the Science and Engineering Council of the Ministry of Power and Electrification, USSR, and it was decided to place four plants in each of two main buildings. The reasons for this decision were that, in addition to infringements of safety practices, installation costs and time would be increased because of a reduction in labor productivity of builders and installation personnel, because installation of building structures and power equipment would be simultaneous. Furthermore, it would be difficult to put the installed equipment into operation in an unfinished building with temporary outside partitions, especially in the Siberian winter. The total GRES would go out of order in the event of any mishap. If two separate buildings are used, there are in effect two separate plants. Smaller buildings are easier to maintain than one large one.

Overhaul work would be facilitated by redundancy of overhead cranes and hoisting devices and more space for overhauling areas. Both buildings would be under the same management, without an increase in staff.

*[All-Union State Institute for the Planning of Electrical Equipment for Heat Engineering Structures]

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